Vol. XXXV FEBRUARY, 1952 No. 9

THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

CONTENTS

The Economic and Social Conditions of Abacá Farmers in Baybay, Leyte . . . . . *Emilio U. Quintana* 451

The Influence of Irrigation on the Growth and Yield of Filler Variety of Philippine Tobacco . . . *Andres P. Aglibut and Rodolfo V. Torreda* 471

A Further Study of the Breeding Habits of Cattle . . . . . *Lourdio L. Clamohoy* . . . 478

Physical Properties of Fibers From Different Leaf Sheaths of an Abacá Stalk . . . . . *Sotero I. Albano, Jr.* 486

Inbred Line Selection in Yellow Flint Corn . . . . . *Rodolfo C. Ylarde* 496

Germination and Variability Study of Seven Abacá Varieties . . . . *Jesus R. Ricahuerta* 504

College and Alumni Notes 515

Published by

THE COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

COMMONWEALTH MYCOLOGICAL INSTITUTE
29 AUG 1953

The Philippine Agriculturist

(University of the Philippines Publications Series A)

Editor

L. B. UICHANCO, SC.D. ..... *Dean, College of Agriculture*

Managing Editor

G. O. OCFEMIA, PH.D. ..... *Professor of Plant Pathology*

Copy Editor

NORA J. CRUZ, A.B. ..... *Instructor in English*

Business Manager

JOSÉ M. CAPINPIN, PH.D. ..... *Associate Professor of Agricultural Botany*

Advisory Board

F. O. SANTOS, PH.D. ..... *Head, Department of Agricultural Chemistry*
VALENTE VILLEGAS, PH.D. ..... *Head, Department of Animal Husbandry*
FRANCISCO M. SACAY, PH.D. ..... *Head, Department of Agricultural Education*
LEON G. GONZALEZ, PH.D. ..... *Head, Department of Agronomy*
A. B. CATAMBAY, M.S. ..... *Head, Department of Agricultural Engineering*
SILVERIO M. CENDAÑA, PH.D. ..... *Assistant Head, Department of Entomology*
NICOLAS L. GALVEZ, PH.D. ..... *Acting Head, Department of Soils*

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

THE PHILIPPINE AGRICULTURIST is published monthly, except in April and May, beginning with Volume 35, by the College of Agriculture and Central Experiment Station, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture and Central Experiment Station, College, Laguna, Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

THE ECONOMIC AND SOCIAL CONDITIONS OF ABACÁ FARMERS IN BAYBAY, LEYTE [1]

EMILIO U. QUINTANA

WITH FOUR TEXT FIGURES

A survey of the economic and social conditions of abacá farmers in Baybay, Leyte, was started in April, 1951, and was completed in February, 1952. The major part of the field work was conducted from April to June, 1951. The survey included 125 abacá farmers residing in the barrios of Gabas, Kilim, Gacat, Candadam, Hibunawan, Maganhan, Igang, Gubang, Cagomay, and Higalo-an. The data were secured through personal interviews with the farmers, their wives, and their older children and were recorded in forms prepared in the Department of Agricultural Education. The data on the farm business covered the crop year 1950 to 1951.

RESULTS AND DISCUSSION

Description of the area surveyed. Baybay is a first class municipality in the southwestern part of Leyte. According to the census of the Philippines for 1939, 2,008.27 hectares were planted to abacá in 1939. Of the ten barrios surveyed, only one has no primary school; three have intermediate schools. The municipality has three high schools: the Baybay National Agricultural School; a branch of the provincial high school which offers a complete general secondary curriculum; and a private institution, the Immaculate Conception College, which offers, besides a complete high-school course, a four-year course in education, a two-year normal course, a two-year course in commerce, and a two-year course in preparatory law.

Age, birthplace, and length of residence of farm operators. The age of the farm operators ranged from 20 to 74 years, or an average of 47.07 years. Twenty per cent of the operators were 60 years old or over. Only 13.6 per cent were below 30 years.

The majority of the operators, or 67.2 per cent, were born in the barrios where they were residing. Twelve per cent were born in other barrios of Baybay. Only 13.6 per cent were born outside the province.

At the time of the survey, the farm operators had lived an average of 40.59 years in the barrios of which they were residents. Only 9.6 per cent had lived in their barrios for less than 21 years.

---

[1] Central Experiment Station Contribution No. 1646. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Education under the direction of Professor Francisco M. Sacay.

[THE PHILIPPINE AGRICULTURIST, Vol. 35, No. 8, January, 1952, appeared in January, 1953]
THE PHILIPPINE AGRICULTURIST, VOL. 35, No. 9, FEBRUARY, 1952.

The operators' average length of residence in the municipality of Baybay was 41.65 years.

Years spent in growing abacá. The operators had been growing abacá for an average of 19.88 years. Only about one-third of the farmers had been engaged in abacá-growing for 10 years or less.

Size and utilization of farm area. The farms ranged in size from one to 35 hectares, or an average of 3.80 hectares. About 62.4 per cent of the farms had an area of three hectares or less. Only 6.4 per cent were over 10 hectares in area.

The farm area was utilized as follows: for field crops, 3.66 hectares, or 96.3 per cent; for farmstead, garden, or orchard, 0.14 hectare, or 3.7 per cent. There were no fixed areas used mainly as pastures.

Capital investment. The average capital investment in a farm was ₱4,674.90, of which 81.2 per cent was invested in land. The next biggest item was buildings, in which 12.6 per cent was invested. The amount invested in work animals represented 3.5 per cent of the capital. The investment in other livestock comprised 2.1 per cent; in tools, 0.3 per cent; and in seeds and supplies, 0.3 per cent.

Of the average capital investment, only ₱439.56 was owned by the landlord; ₱4,235.35 was owned by the farm operators. The landlords owned 13.3 per cent of the amount invested in land and 6.4 per cent of that invested in work animals.

Important crops grown. Abacá, the major crop, was grown by all the farmers (table 1). The total area planted to abacá was 286.70 hectares, or an average of 2.29 hectares to a farm. Coconut, the second important crop, was grown by 56.8 per cent of the farmers; the average area planted to it was 0.58 hectare. Rice was raised by 56 per cent of the farmers; the average area planted to it on each farm was 0.44 hectare. The minor crops were corn, sweet potato, peanut, and gabi. Vegetables could be purchased cheaply in the market and were not, therefore, extensively grown by the abacá growers. The other groups of farmers raised vegetables. Banana was the only fruit crop grown to an appreciable extent.

Important livestock raised. Although the carabao was the only work animal used, it was found on only 69.6 per cent of the farms. The average number raised on these farms was 1.32. On about one-fourth of the farms, carabaos were kept for breeding purposes. Swine were raised by 67.2 per cent of the farmers, chickens by 66.4 per cent, and ducks by 4 per cent. A few cattle, horses, goats, and sheep were found on the farms (table 2).

Farm receipts and expenses. The crop receipts averaged ₱593.56, of which 50.8 per cent came from abacá (table 3). At the time of the survey, the cost of fiber ranged from ₱0.40 to ₱0.70 a kilo, or an average of ₱0.55. Other important sources of income were coconut, rice, corn, gabi, sweet potato, peanut, nipa, banana,

and vegetables. From coconut was obtained ₱174.94, or 29.47 per cent of the total crop receipts; from rice, ₱96.88, or 16.32 per cent. The receipts from sweet potato, gabi, nipa, peanut, banana, and vegetables were meager.

The total receipts from a farm averaged ₱694.14. Of this amount, 87.71 per cent came from the sale of farm crops. The amount from the sale of fruits, vegetables, and livestock products comprised only 7.04 per cent of the farm receipts (table 4).

Farm expenses averaged ₱329.16 to a farm. The most important item of expense was the harvesters' share, which comprised 35.27 per cent of the total expenses. Cash expenses amounted to ₱91.72, or 27.86 per cent. Other items of expense were land rent, 15.6 per cent; unpaid family labor, 11.9 per cent; and decrease of capital, 9.4 per cent (table 5).

Labor income and labor earning. The labor income of a farm averaged ₱105.44 (table 6). This amount represented what the farmer received for his year's work, in addition to having a house to live in and farm products to use at home.

The farm privileges amounted to ₱264.37, of which ₱175.37, or 66.3 per cent, was farm crops. The next biggest item was rental value of dwelling, which averaged ₱63.00, or 23.8 per cent of the total privileges. Livestock and livestock products constituted 6.4 per cent; fruits and vegetables, 3.5 per cent (table 7).

The operator's labor earnings, which included the value of farm privileges, averaged ₱369.81 (table 8).

Family income and amount available for family living. The average family income was ₱611.17 (table 9). This amount included the income of the operator as well as that of other members of the family. Of the total family income, 90.1 per cent was earned by the operator, who supplemented his income from the farm by devoting part of his time to fishing, lumbering, and working as a laborer. This supplementary income amounted to ₱181.00, or 29.6 per cent of the family income. Other members of the family contributed ₱60.36, or 8.1 per cent of the total.

The average amount available for family living was ₱870.71, or ₱194.39 for each family member (table 10).

Cost of producing abacá fiber from a hectare. The cost of producing abacá fiber from a hectare amounted to ₱156.95. Of this amount, cutting stalks and making tuxies comprised ₱50.64, or 32.3 per cent. The interest and taxes on land amounted to ₱40.61, or 25.8 per cent; cleaning the abacá field, ₱32.15, or 20.5 per cent; stripping, ₱20.12, or 12.8 per cent; drying, hauling by man- and animal-labor, and depreciation and interest of tools and implements, ₱12.23, or 7.8 per cent.

On the average, one hectare of land yielded 337.17 kilos. This low yield was due to the old age and poor condition of the planta-

tion. The cost of producing a kilo of fiber was ₱0.47; the average selling price of a kilo was ₱0.55. The net gain was ₱28.25 a hectare (table 11).

Cost a hectare of bringing abacá plants to harvesting age. The cost of bringing abacá plants to average harvesting age, 2.74 years, amounted to ₱163.31 a hectare. Of this amount, man labor comprised 52.4 per cent; land (interest and taxes), 40.8 per cent; and planting materials, 5.5 per cent. The cost of tools and equipment was very small because only bolos, hatchets, and sharpened sticks were used (table 12).

Farm practices. The abacá varieties planted by the farmers were Inosa, Laguis, Baguis, Alman. and Linawa-an. The Inosa variety, the most common, was planted by 73.6 per cent of the farm operators. Planting of different varieties side by side was practiced by 22.4 per cent. In planting, 93.6 per cent of the farmers used suckers (maiden leaf and sword leaf). Most farmers secured their planting materials from nearby fields.

There was no definite month for planting abacá. About 38.4 per cent of the farmers usually planted abacá in August; 10.4 per cent, in July; 18.4 per cent, in September; and 32.8 per cent, in the other months of the year. Nor was there a definite month for cleaning the abacá fields. Thirty-seven farmers, or 29.6 per cent, generally cleaned their fields in February; 22.4 per cent, in August; 36.0 per cent, in September; and 12.0 per cent, in the other months of the year. Most of the farmers cleaned their abacá fields twice a year; each cleaning preceded stripping. There was no fixed distance of planting. Not one farmer practiced cultivation of the field, fertilization, cover-cropping, or control of diseases. Only in three farms were insects driven out by the practice of burning dried leaves in vacant lots in the field.

Eighty-two farmers, or 65.4 per cent, started to harvest three years after planting. Harvesting usually took place in February, when the farmers had finished planting their secondary crops, such as rice, corn, and sweet potato. All the farmers used the native "hagutan" (shoulder-high) with serrated knives for stripping the abacá (fig. 1). All the farmers dried their fiber under the sun by hanging the fiber on abacá strings tied between two poles (fig. 2). They did not have drying sheds as a provision against inclement weather. Most farmers directly transported their fiber from the field to the fiber merchant. The dry fibers were baled and sold to merchants staying near the abacá plantations because the cost of hauling was a big item of expense. Only 1 per cent of the 125 farmers surveyed kept records of his farming business. Stripping twice a year was practiced by 53.6 per cent of the farmers; 46.4 per cent stripped their abacá only once a year. The fiber was trans-

Fig. 1.—Hand-stripping abacá fiber in a native "hagutan" (shoulder-high) with serrated knife.

Fig. 2.—Drying fiber in the sun.

ported by man, generally, (fig. 3) to a local merchant. The abacá was weighed by the local merchant (fig. 4). About 45 per cent of the farmers claimed that abacá could still be harvested from a plantation 20 years old. Renovation of the plantation was not practiced by the farmers surveyed. The farm practices followed by this group of farmers were still far from efficient (table 13).

Fig. 3.—Transporting fiber to market.

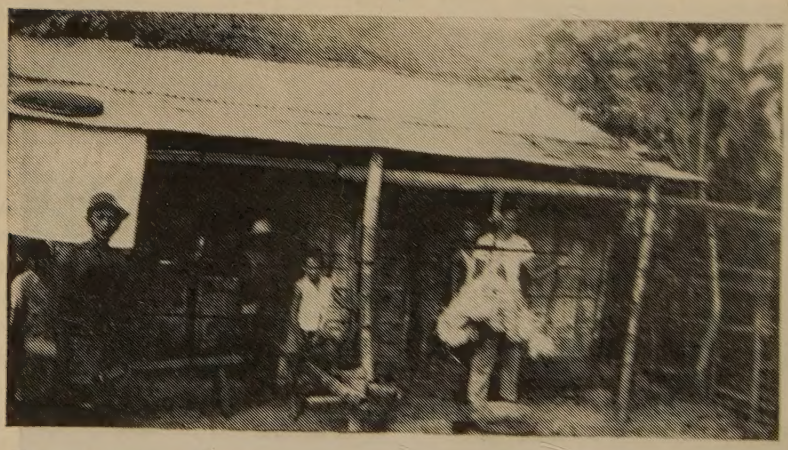

Fig. 4.—A local merchant weighing fiber sold by a farmer. This merchant also maintains a "sari-sari" store.

Types of households. The most common household was the husband-wife-one-child type, which formed 16 per cent of all the different types. The next common household was the husband-wife-

three-children type, which constituted 13.6 per cent. Of the 125 families surveyed, 12.8 per cent were childless couples. Only 0.8 per cent had nine children (table 14).

Table 15 shows that households of three members each were the most common, representing 17.6 per cent of the total. This type was followed by households consisting of two, four, five, or six members. The average household had 4.48 individuals.

The children comprised 58.1 per cent of the household members; the parents, 39.9 per cent. Only 2 per cent of the members of the household were relatives. Strong family ties did not allow members of a family to live with relatives (table 16).

Type, size, and value of dwellings. The most common type of dwelling had bamboo walls, a bamboo floor, and a nipa roof. Nipa and bamboo are abundant in Baybay and can be bought at low prices. Cogon and coconut leaves were used as roofing materials by the poorest families; these dwellings represented only 4.8 per cent. Only seven dwellings, or 5.6 per cent, which were built before World War II, had galvanized iron roofs (table 17).

As shown in table 18, the average floor area of a dwelling was 39.93 square meters, or 14.10 square meters to a person. The average dwelling had 2.84 rooms and housed 4.48 individuals. The average number of persons to a room was 1.59.

The value of the dwellings ranged from ₱12.00 to ₱5,000.00, or an average of ₱586.16 (table 19). About two-thirds of the dwellings cost ₱300 or less.

Home facilities and conveniences. The most common conveniences and facilities in the homes of the farmers were wooden benches, dining tables, bamboo chairs, wooden chairs, wooden beds, flatirons, and sewing machines. About 17.6 per cent had guitars, and 15.3 per cent, clocks. Only one household had a phonograph; another had a radio. Not a single home had electric lights. The majority of the families, or 92.12 per cent, got drinking water from small wells dug along the river banks. Only 2.4 per cent got their drinking water from water piped to the yard, and only one family had running water in the house. About 15.3 per cent of the households had water containers with faucets. In general, the homes had limited conveniences and facilities.

Home beautification. Some of the farmers made attempts to beautify their homes. Of the homes surveyed, 34.7 per cent had hedges around the house; 33.9 per cent had hedges along the walk to the stairs; 16.1 per cent had group plantings; 11.3 per cent had potted plants in the house; 10.5 per cent had potted plants in the yard; 10.5 per cent had climbing plants around the house; and 9.7 per cent had hedges on the front boundary of the farmstead. Only 8.9 per cent had hedges on the side boundaries.

School attendance of farm operators' children. Of the children 7 to 14 years old, 80 per cent of the boys and 59 per cent of the girls

were in school. Of those 15 to 19 years old who still lived with their parents, 61.54 per cent of the boys and 65.7 per cent of the girls were in school. Of the children 20 to 24 years old who still lived with their parents, 41.67 per cent of the boys and 39.13 per cent of the girls were in school. Of the children 7 to 24 years old, 72.39 per cent of the boys and 71.77 per cent of the girls were in school.

Educational attainment of farm operators' in-school children. Boys 7 to 14 years old who were still in school had completed an average of 2.92 grades, and the girls, an average of 3.45. The boys 15 to 24 years of age who were still in school had completed an average of 6.6 grades; the girls, an average of 6.37. The highest educational attainment of the operators' children was second-year college.

Educational attainment of farm operators and their out-of-school children. Of the out-of-school children 7 to 14 years old who were still living with their parents, the boys had completed an average of 1.75 grades and the girls, an average of 0.77. Of those 15 to 24 years old who were still living with their parents, the boys had had an average schooling of 4.10 grades; the girls, 4.57. Both groups had completed an average of 4.32 grades. The highest grade reached by this age group was third-year high school.

The average grade completed by the farm operators was 1.5. These farm operators did not have high educational attainments because their parents, as was common in the past, were not interested in sending their children to school, probably because they were not in a position to finance their children's studies. Of the total number of farm operators, 65.6 per cent had never attended school.

Books and current periodicals in farm homes. The most popular reading matter in the farm homes was the *Bisaya*, a vernacular magazine published and printed in Cebu. The *Philippines Free Press* was found in only five homes, or 4 per cent of the total number of farm homes. The *Manila Times* was found in only one home. Other local magazines, such as *Saloma*, *Liwayway*, *Bulaklak*, *Kislap*, *Lamdag*, and *Komiks*, were also read in some homes. Sixty-two homes, or 49.6 per cent, did not have any reading matter.

Common recreational activities. Drinking tuba, dancing, cockfighting, and attending vernacular plays, parties, fiestas, and public meetings were the most common recreational activities of the farmers. Among the wives, the most common activities were going to the moving pictures, watching vernacular dramas, dancing, and attending parties and fiestas. Watching the moving pictures and vernacular dramas, going to dances, attending parties, and swimming in the river and the sea were the most common leisure-time activities among the sons 10 years and over. Going to the moving pictures and dramas, dancing, attending picnics, going to parties, and playing ball games were popular among the daughters 10 years old and over.

Membership in organizations. Most of the parents were members of some local organization. About two-thirds were members of parent-teacher associations. Fourteen fathers and fourteen mothers belonged to a religious organization known as "Kapunongan capilla sa taga barrio." Of the children who were 10 years old and over, only 19 of the sons and 11 of the daughters were members of the student body organizations of the schools they attended.

SUMMARY

The findings of the survey reveal that the economic and social conditions of abacá farmers in Baybay, Leyte, are still far from satisfactory. The farmers have small incomes because of insufficient land being cultivated, inadequate tools and equipment, limited number of work animals and other livestock, and unimproved methods of growing crops. To increase their income and thereby improve their standard of living, these farmers should increase the size of their farms, adopt improved methods of producing crops and raising livestock, and use better tools and equipment. They should be taught better methods of farming through a program of adult education and agricultural extension.

Some of the findings of the survey are the following:

1. The operators had been engaged in abacá farming for an average of 19.88 years.

2. The average size of a farm was 3.80 hectares. Of this farm area, 96.3 per cent was utilized for crops and 3.7 per cent, for farmsteads, gardens, and orchards. The most important crops grown were abacá, coconut, rice, corn, and sweet potato.

3. The average capital investment was ₱4,674.90, of which 81.2 per cent was invested in land, 12.6 per cent in buildings, 3.5 per cent in work animals, 2.1 per cent in other livestock, and 0.3 per cent in tools. About 99.0 per cent of the average capital investment belonged to the farmers.

4. The carabao was the work animal used on the farm. Each farm had an average of 1.32 carabaos.

5. The average crop receipts was ₱593.56, of which 50.8 per cent was from abacá. The average cost of producing abacá fiber from a hectare was ₱156.95, or ₱0.47 a kilo of fiber. One hectare of abacá land yielded 337.17 kilos of dry fiber. The average cost of bringing abacá plants to the harvesting age of 2.74 years was ₱163.31 a hectare. Primitive methods of abacá farming were employed. Different varieties were planted side by side. The farmers did not use fertilizers and did not practice cover-cropping.

6. The farm expenses averaged ₱329.16 for each farm. The harvesters' share was 35.2 per cent of the total expenses. The labor income averaged ₱105.44; labor earnings, ₱369.81; family income, ₱611.17; and amount available for family living, ₱870.71, or an average of ₱194.39 for each family member.

7. The most common type of household was the husband-wife-one-child type. The average household had 4.48 members.

8. Most of the houses had nipa roofs and bamboo walls and floors. Only seven homes had G.I. roofings. The average value of a dwelling was ₱586.16. The farmers did not have adequate home facilities and conveniences. Some made attempts to beautify their homes.

9. Of the out-of-school children 7 to 14 years old, the boys had completed an average grade of 1.75, and the girls, 0.77. Of those 15 to 24 years old, the boys had completed an average grade of 4.10, and the girls, 4.57. The average grade completed by farm operators was 1.5.

10. The most common reading matter in the farm homes was the *Bisaya,* a vernacular magazine published in Cebu. Dancing, cockfighting, drinking tuba, and attending vernacular dramas and parties were the most common recreational activities of the farmers. Going to the moving pictures, attending vernacular plays, dancing, and attending parties and fiestas were popular among the wives.

11. About one-half of the parents belonged to parent-teacher associations. A few belonged to a religious organization.

TABLE 1

Important crops grown

KIND OF CROP	NUMBER OF FARMS	AREA PLANTED	PROPORTION	AREA OF EACH FARM RAISING CROP	AVERAGE FOR ALL FARMS
		hectares	*per cent*	*hectares*	*hectares*
Farm crops:					
Abacá	125	286.70	100	2.29	2.29
Rice	70	55.27	56	0.79	0.44
Coconut	71	72.80	56.8	1.03	0.58
Corn	37	25.18	29.6	0.68	0.20
Sweet potato	38	15.35	30.4	0.40	0.13
Nipa	2	1.5	1.6	.75	0.012
Peanut	1	.5	.8	.50	0.004
Gabi	1	.5	.8	.5	0.044
Vegetables	1	.45	.8	.45	0.003
Fruits:					
Banana	44	17.10	32.50	.39	.14

TABLE 2

Livestock raised

KIND OF LIVESTOCK	NUMBER OF FARMS	PERCENTAGE	NUMBER OF ANIMALS	AVERAGE FOR A FARM RAISING ANIMALS	AVERAGE OF ALL KINDS
Work animals:					
Carabaos	87	69.6	115	1.32	0.92
Productive livestock:					
Carabaos	33	26.4	50	1.51	0.40
Cattle	1	0.8	2	0.02	0.02
Horses	1	0.8	1	0.01	0.01
Swine	84	67.2	165	1.96	1.32
Goats	4	3.2	8	2.00	0.08
Sheep	1	0.8	4	4.00	0.04
Chickens	83	66.4	563	6.74	4.48
Ducks	5	4.0	14	2.80	0.11

TABLE 3

Receipts from crops

CROP	AMOUNT	
	pesos	*per cent*
Abacá	301.49	50.8
Coconut	174.94	29.5
Corn	10.29	1.7
Rice (lowland)	96.88	16.3
Gabi and peanut	1.20	0.2
Sweet potato	4.32	0.7
Nipa	.64	0.1
Banana	3.48	0.6
Vegetables	.32	0.1
Total	593.56	100.0

TABLE 4

Farm receipts [a]

SOURCE OF RECEIPTS	AVERAGE TO A FARM	
	pesos	*per cent*
Farm crops	593.56	87.7
Fruits and vegetables	3.80	0.5
Livestock and products	53.80	6.6
Increase of capital	42.98	5.2
Total	694.14	100.0

[a] Excluding worth of products used at home.

TABLE 5

Farm expenses

NATURE OF EXPENSE	AMOUNT	
	pesos	*per cent*
Cash expenses	91.72	27.9
Unpaid family labor	39.24	11.9
Decrease of capital	30.83	9.4
Land rent (landlord's share)	51.27	15.6
Harvester's share	116.10	35.2
Total	329.16	100.0

TABLE 6

Labor income representing amount farmer receive for a year's work[a]

ITEM	AVERAGE TO A FARM
Farm receipts	694.14
Farm expenses	329.16
Net farm income	364.98
Interest at 6 per cent on average investment	259.54
Labor income	105.44

[a] Excluding farm expenses and the interest on the investment.

TABLE 7

Farm privileges

ITEM	AVERAGE TO A FARM	
	pesos	*per cent*
Farm crops	175.37	66.3
Fruits and vegetables	9.19	3.5
Livestock and products	16.81	6.4
Rental value of dwelling	63.00	23.8
Total	264.37	100.0

TABLE 8

Operator's labor earnings from the farm

ITEM	AVERAGE TO A FARM
	pesos
Farm receipts	694.14
Farm privileges	264.37
Farm receipts plus farm privileges[a]	958.51
Farm expenses	329.16
Net farm income plus privileges	629.35
Interest at 6 per cent on capital investment	259.54
Operator's labor earnings	369.81

[a] Gross income.

TABLE 9

Family income

ITEM	AVERAGE TO A FARM	
	pesos	*per cent*
Operator's income:		
From farm	369.81	60.5
From job off the farm	181.00	29.6
Operator's total income	550.81	90.1
Income of other members of the family:		
Income from farm (charged as expense)	39.24	6.4
Income from job off the farm	21.12	3.5
Total income of other members of the family	60.36	8.1
Total family income	611.17	100.0

TABLE 10

Amount available for family living

ITEM	AVERAGE TO A FARM
	pesos
Total family income	611.17
Interest earned by operator's capital	259.54
Amount available for family living	870.71
Average size of household	4.48
Amount available for each member of the household	194.39

TABLE 11

Cost of producing fiber from one hectare

ITEM	TIME INVOLVED	COST	
	days	*pesos*	*per cent*
Man labor:			
Cleaning the abacá field	28.96	32.15	20.5
Cutting stalks and making tuxies	45.62	50.64	32.3
Making and mounting stripping apparatus	1.00	1.11	0.7
Stripping	18.13	20.12	12.8
Drying	4.27	4.74	3.0
Baling and hauling	6.06	6.73	4.3
Animal labor: hauling	.09	.09	0.1
Indirect expenses:			
Land (interest and taxes)		40.61	25.8
Tools and implements (depreciation and interest)		.076	0.5
Total	104.13	156.95	100.0
Yield of fiber to a hectare in kilos		337.17	
Cost of producing 1 kilo of fiber		0.47	
Selling price of 1 kilo of fiber		0.55	
Total value of production to a hectare		185.45	
Net gain to a hectare		28.25	

TABLE 12

Cost of bringing one hectare of abacá to average harvesting age (2.74 years)

ITEM	COST	
	pesos	*per cent*
Material:		
Suckers and corms	9.05	5.5
Labor:		
Man (cleaning, planting, weeding, and replanting)	85.62	52.4
Indirect expenses:		
Land[a] (interest and taxes)	66.60	40.8
Tools (depreciation and interest)	2.04	1.3
Total	163.31	100.0

[a] Value of land averaged ₱306.29 a hectare.

TABLE 13

Abacá-growing practices

PRACTICE	NUMBER OF FARMERS	PERCENTAGE
Variety used:		
Inosa	92	73.6
Laguis	5	4.0
Mixed varieties Inosa, Laguis, Baguis, Alman, and Linawa-an)	28	22.4
Kind of planting materials:		
Suckers (maiden and sword leaves)	117	83.6
Suckers and corms	3	2.4
Corms	5	4.0
Source of planting materials:		
Neighboring fields	65	52.0
Adjoining fields	19	15.0
Plants found in the field to be planted	41	32.8
Month of planting:		
July	13	10.4
August	48	38.4
September	23	18.4
Other months of the year	41	32.8
Month of cleaning the abacá field:		
February	37	29.6
August	28	22.4
September	45	36.0
Other months of the year	15	12.0
Frequency of cleaning:		
Twice a year	88	70.4
Once a year	34	27.2
Thrice a year	3	2.4
Distance of planting:		
1.5 × 1.5 meters apart	19	15.2
2.0 × 2.0 " "	25	20.0
2.5 × 2.5 " "	5	40.0
3.0 × 3.0 " "	50	40.0
Other distances	26	20.8
Cultivation of abacá field	0	0.0
Fertilization of abacá field	0	0.0
Cover-cropping of field	0	0.0
Control of pests by burning dried leaves	3	2.4
Control of diseases	0	0.0
Age of plants at harvest:		
One and one-half years after planting	1	0.8
Two years after planting	32	25.6
Two and one-half years after planting	5	4.0
Three years after planting	82	65.4
Three and one-half years after planting	3	2.4
Four years after planting	2	1.6
Month of harvesting:		
February	49	39.2
September	43	34.4
Other months of the year	33	26.4
Method of stripping:		
Using native "hagutan"	125	100.0
Frequency of harvesting:		
Once a year	58	46.4
Twice a year	67	53.6
Method of drying the fiber:		
Sun-drying	125	100.0

PRACTICE	NUMBER OF FARMERS	PERCENTAGE
Method of storing the fiber:		
Stored in homes	17	13.6
Not stored, but transported direct to the market	108	86.4
Method of transporting the fiber to market:		
Combination of man and animal	2	1.6
Animal-drawn sled	1	0.8
Carried by man	122	97.6
Person to whom crops sold:		
Local merchants	125	100.0
Keeping of records:		
Keeps records	1	0.8
Do not keep records	124	92.2
Estimated number of years possible to harvest:		
10 years or less	32	25.6
11 to 20 years	58	46.4
21 to 30 years	29	23.2
31 to 40 years	3	2.4
No definite estimate	3	2.4

TABLE 14

Types of households

TYPE OF HOUSEHOLD	NUMBER	PERCENTAGE
Husband–wife	16	12.8
Husband–wife–children:		
Husband–wife–one child	20	16.0
" " two children	14	11.2
" " three children	17	13.6
" " four children	15	12.0
" " five children	10	8.0
" " six children	7	5.6
" " seven children	0	0.0
" " eight children	0	0.0
" " nine children	1	0.8
Husband–wife–children–relatives	1	0.8
Husband (or wife)–children	15	12.0
Single individual	5	4.0
No marital relation	4	3.2
Total	125	100.0

TABLE 15

Number of individuals in the household

NUMBER OF PERSONS	NUMBER OF HOUSEHOLDS	PERCENTAGE
1	5	4.0
2	20	16.0
3	22	17.6
4	20	16.0
5	18	14.4
6	18	14.4
7	11	8.8
8	9	7.2
9	0	0.0
10	0	0.0
11	2	1.6
Average number of persons ..	125	100.00
Total	4.48	

TABLE 16

Classification of members in the household

MEMBERS	MALE	FEMALE	TOTAL		
			Number	Average	Percentage
Parents	108	114	222	1.78	39.9
Children	164	160	324	2.59	58.1
Relatives	6	5	11	0.11	2.0
	278	279	557	4.48	100.0

TABLE 17

Classification of dwellings according to materials used

CLASS	NUMBER	PERCENTAGE
Class A—G. I. roofing	7	5.6
Class B—G. I. and aluminum roofing	1	0.8
Aluminum	2	1.6
Class C—Nipa roof:		
Wooden wall, wooden floor	29	23.4
Bamboo wall, wooden floor	8	6.5
Bamboo wall, bamboo floor	36	29.1
Nipa wall, bamboo floor	14	11.4
Nipa wall, wooden floor	2	1.6
Abacá wall, bamboo floor	1	0.8
Wooden wall, mixed floor	1	0.8
Bamboo wall, mixed floor	3	2.4
Mixed wall, wooden floor	4	3.2
Mixed wall, bamboo floor	4	3.2
Coconut-leaf wall, bamboo floor	1	0.8
Mixed wall, mixed floor	3	2.4
Class D—Cogon roof	4	3.2
Class E—Coconut thatched leaves	2	1.6
Class F—Nipa and G. I. roofing	2	1.6
Total	124	100.0

TABLE 18

Size of dwellings and number of rooms

ITEM	NUMBER
Number of dwellings	124.00
Floor area of dwelling in square meters	39.93
Floor area to a person in square meters	14.10
Number of rooms	351.00
Number of rooms to a dwelling	2.83
Number of persons to a dwelling	4.48
Number of persons to a room	1.59

TABLE 19

Value of dwellings

VALUE IN PESOS [a]	NUMBER	PERCENTAGE
100 and below	39	31.5
101–200	17	13.7
201–300	12	9.7
301–400	4	3.2
401–500	15	12.2
501–600	3	2.4
601–700	2	1.6
701–800	9	7.3
801–900	2	1.6
901–1000	6	4.8
1001–1200	0	0.0
1201–1300	0	0.0
1301–1400	0	0.0
1401–1500	4	3.2
1501–1600	0	0.0
1601–1700	0	0.0
1701–1800	2	1.6
1801–1900	0	0.0
1901–2000	4	3.2
2001–2500	0	0.0
2501–2900	1	0.8
2901–3000	0	0.0
3001 and over	4	3.2
Total	124 [b]	100.0

[a] Average cost, ₱586.16.
[b] One farmer had no house of his own.

THE INFLUENCE OF IRRIGATION ON THE GROWTH AND YIELD OF FILLER VARIETY OF PHILIPPINE TOBACCO [1]

ANDRES P. AGLIBUT AND RODOLFO V. TORREDA

Irrigation of tobacco is not common in the Philippines except in some parts of La Union province where tobacco fields are irrigated two or three times during the growing period of the plants. In the United States, tobacco is irrigated to increase production and to improve the quality of the leaf crop.

According to Killebrew and Myrick,[2] irrigation is a great aid in getting a good "start" of plants though an oversupply of moisture has a deleterious effect. Carr [3] found that removal of excess water by drainage during periods of heavy rainfall is as essential as furnishing an adequate supply of moisture during dry periods. LaPadre and Carr [4] reported that a monthly rainfall of 3.15 to 4.21 inches is ideal for excellent yield and quality of tobacco for average tobacco soils.

A study to determine the influence of different amounts and frequencies of irrigation on the growth and yield of filler variety of Philippine tobacco was conducted in the experimental yard behind the Agricultural Botany building, in the laboratory of the Department of Agronomy, and in the Department of Agricultural Engineering from December, 1950, to March, 1952.

MATERIALS AND METHODS

Plan of the experiment. The land was plowed, harrowed, and leveled. Twenty-one rows were laid 80 centimeters apart, and in each row ten 1-foot cube holes, 70 centimeters apart, were dug. The soil removed from the 210 holes was mixed and later plowed back in equal quantities and uniform compactness into the holes. Each refilled hole served as a plant bed for one seedling.

There were ten plants in a row, and to each row was assigned at random a corresponding irrigation treatment.

---

[1] Central Experiment Station Contribution No. 1647. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Engineering.

[2] KILLEBREW, J. B., AND H. MYRICK. 1909. Tobacco leaf, its culture and cure, marketing and manufacturing. xiv + 506 p., 145 fig. New York: Orange Judd Publishing Company, Inc.

[3] CARR, J. M. 1943. Tobacco plant production in the coastal plain of Georgia. Georgia Coastal Plain Exper. Sta. Bull. 38.

[4] LAPADRE, J. L., AND J. M. CARR. 1943. Fertilizing type 62 shade tobacco. Georgia Coastal Plain Exper. Sta. Bull. 39.

The experimental design in replications 1 and 2 was as follows:

AMOUNT OF IRRIGATION WATER APPLIED, IN PERCENTAGE OF WATER-HOLDING CAPACITY OF THE SOIL AND IN LITERS	NUMBER OF PLANTS IN EACH FREQUENCY OF IRRIGATION IN DAYS[a]					TOTAL NUMBER OF PLANTS
	2	4	6	8	10	
0			Control			10
10						
2.05 liters (2.21 ha.–cm. per ha.)	10	10	10	10	10	50
20						
4.10 liters (4.41 ha.–cm. per ha.)	10	10	10	10	10	50
30						
6.15 liters (6.61 ha.–cm. per ha.)	10	10	10	10	10	50
40						
8.20 liters (8.82 ha.–cm. per ha.)	10	10	10	10	10	50
Total	40	40	40	40	40	210

[a] Irrigation was done once during the time indicated.

Determination of the water-holding capacity of the soil. A sufficient sample of the composite soil mixture described above was pulverized, sifted through a 7-millimeter wire screen, and taken to the Department of Soils for determination of its water-holding capacity. The analysis showed that at a depth of one foot the sample had a water-holding capacity of 52.78 per cent, air-dry basis, or 64.95 per cent, oven-dry basis, and a specific gravity of 1.37. From the specific gravity of the soil, a density of 38.85 kilograms for each cubic foot was determined.

Irrigation. Based on the weight and the water-holding capacity of the soil placed in each hole, the computed amounts of irrigation water were as follows: for 10 per cent of the water-holding capacity, 2.05 liters (2.21 ha.-cm. per ha.); for 20 per cent, 4.10 liters (4.41 ha.-cm. per ha.); for 30 per cent, 6.15 liters (6.61 ha.-cm. per ha.); and for 40 per cent, 8.20 liters (8.82 ha.-cm. per ha.). Each of these amounts was given once at every 2-, 4-, 6-, 8-, and 10-day interval to the corresponding lot except to the control lot which was not irrigated. The seedlings were watered daily during the first two weeks after transplanting. The experimental treatments were begun on the third week. The amounts of water sprinkled on the different treatments were measured by caliberated galion cans. The plants were watered around and as close to the base as possible in the afternoons, except on rainy days. Irrigation treatments ended on April 30, 1951.

Transplanting. One-month-old tobacco seedlings of the Wisconsin Seedleaf filler variety for both the first and second replications were transplanted in the afternoon of January 6, 1951. Only one vigorous seedling was planted in each prepared bed. The seedlings were watered uniformly immediately after transplanting to give them a good start. They were covered with banana bracts

during the first five days after transplanting to protect them from excessive heat.

Care, harvesting, and curing. Every plant received identical care and cultivation. The flower buds were not pinched off as doing so might influence the yield of the plants. Likewise, suckering was not practiced. Harvesting was done by priming; the leaves were removed singly from the stalks as they matured. The leaves were considered mature when their edges and tips turned yellow, when spots appeared on their surfaces, and when their color became lighter.

In every treatment, priming was done by the row at 9 o'clock in the morning at weekly intervals. It took six primings to complete the harvest. The leaves were taken to the curing laboratory, and their lengths from the tip to the base of the petioles and widths at the broadest part were measured.

The leaves were poled by the Cuban method described by Paguirigan.[5] A big steel needle, threaded with two meters of abacá twine tied to one end of a wooden pole, was passed through the base of the midribs of the leaves strung alternately back to back, so that the leaves rode alternately on the pole. The poles were hung on the curing racks in the Department of Agronomy. The weight of air-cured leaves was taken ten or twenty days after harvesting.

RESULTS AND DISCUSSION

Infuence of amount and interval of irrigation on growth. The different amounts of irrigation applied at the same intervals produced unequal growth, in the same way that the same amount of irrigation applied at different intervals produced unequal rates of growth. In the first replication, the plants which received 6.15 liters grew at faster rates and reached taller heights than those given other amounts of irrigation; the plants in treatments 2, 4, and 1 followed closely. In the second replication, the plants which received 8.2 liters grew fastest and reached the greatest height, with those in treatments, 3, 2, and 1 following in the order given.

Irrigating with 2.05 liters at different intervals resulted in varying rates of growth, with the plants irrigated once in four days attaining the best mean height of 88.6 centimeters. The plants irrigated with the same amount once in six days reached the maximum mean height of 85.49 centimeters, and those irrigated at 2-day intervals attained the height of 75.73 centimeters. The mean height of the unirrigated plants was the same as those irrigated once in ten days, but higher than those irrigated once in eight days. In the second replication, a similar tendency of plant growth prevailed.

Given 4.10 liters of water, the plants in the first replication, which were irrigated at 2-, 4-, and 6-day intervals, had identical

[5] PAGUIRIGAN, D. B. 1917. The production of wrapper tobacco under shade in the Philippines. Philippine Agriculturist 5: 39–49.

growth. Those plants watered once every four days attained the maximum average height of 99.10 centimeters, and those irrigated once in six days attained 97.08 centimeters. Almost the same growth behavior was observed in the second replication, the total growth being more in the plants which received more frequent irrigation.

Increasing the amount of irrigation to 6.15 liters to a plant gave plants irrigated at 8-day intervals an average total growth of 115.60 centimeters; at 6-day intervals, 112.38 centimeters; at 4-day intervals, 106.59 centimeters; and at 10-day intervals, 100.26 centimeters. The results show that heavier irrigation may be applied at longer intervals. Similar results were obtained in the second replication, with the plants irrigated at 6-day intervals producing the biggest average total growth of 115.99 centimeters and those irrigated at 8-day intervals measuring 109.72 centimeters.

When the amount of irrigation was increased further to 8.20 liters to every plant, longer irrigation intervals, or less frequent irrigation, produced the highest average total growth in both replications. The plants in the second replication had a wider height variation than those in the first replication.

Influence af amount and interval of irrigation on number of leaves. For each interval, the amounts of water applied to each plant which produced the highest number of leaves and the highest numerical average in the first replication were as follows: 2-day interval, 4.10 liters; 4-day interval, 6.15 liters; 6-day interval, 8.20 liters; 8-day interval, 4.10 liters; and 10-day interval, 8.20 liters. The plants irrigated once in eight days with 4.10 liters had the most leaves and the highest numerical average of 27.2 leaves.

For the different rates of application, the corresponding intervals which gave the highest total number of leaves and highest numerical average were as follows: 2.05 liters, 6-day interval; 4.10 liters, 8-day interval; 6.15 liters, 8-day interval; and 8.20 liters, 6-day interval. In the second replication, the plants irrigated with 6.15 liters and 8.20 liters yielded the highest number of leaves and the highest numerical average. The heaviest irrigation of 8.20 liters to a plant when applied once in every ten days produced the highest number of 153 leaves and a corresponding average of 19.1 leaves. In this replication heavier irrigations applied at longer intervals yielded better crops of leaves than the lighter irrigations.

Influence of amount and frequency of irrigation on size of leaves. The size of leaves appeared to be influenced by the amount and frequency of irrigation. In the first replication irrigated with 2.05 liters, the widest leaves were produced by the plants irrigated at 4-day intervals, and the longest leaves by those irrigated at 2-day intervals. The widest leaves were produced when 4.10 liters of irrigation was applied once every six days, and the longest when irrigation was once every four days. When 6.15 liters was used, the widest and longest leaves were gathered from the plants irrigated

once every eight days. The amount of 8.20 liters produced the widest leaves in plants irrigated once every eight days and the longest in those watered once every four days.

In the second replication, the widest and longest leaves were harvested from the plants irrigated once every ten days with 8.20 liters of water. As a group, the plants which received 8.20 liters of irrigation produced broader and longer leaves than those which received different rates at varying intervals. Although the leaves from the plants irrigated with 2.05 liters were narrower and shorter than those from the other irrigation treatments, they were more uniform in width and length.

Influence of irrigation on weight of leaves. The most important concern of a filler tobacco farmer is the production of a heavier and better-quality crop of cured leaves. In the first replication, the heaviest crop of cured leaves came from the plants irrigated once every eight days with 6.15 liters of water. The total weight of these leaves (866.30 grams), as well as their average weight (108.28 grams), greatly surpassed the total weight (177.30 grams) and the average weight of the cured leaves (29.50 grams) from the unirrigated plants. In general, the 6.15-liter irrigation produced heavier total and average weights of leaves than the other amounts of irrigation. However, 8.2 liters applied at different intervals produced a more uniform weight of cured leaves than 6.15 liters.

In the second replication, a total of 710 grams of cured leaves, or an average of 88.75 grams, was harvested from the plants given 8.20 liters irrigation every ten days. As in the first replication, the 6.15-liter irrigation gave better total and average yields than the other amounts of irrigation. All the irrigated plants, except those given 2.05 liters at longer intervals, produced much heavier total and average yields of cured leaves than the unirrigated or control plants.

When lighter irrigations were given, more frequent application produced heavier crops than less frequent application. Conversely, heavier irrigations applied at longer intervals produced heavier crops of cured leaves than those given at shorter intervals. These observations hold true in both replications.

Plant deaths. Unusual variation in resistance was noted among the cultures in the first and second replications. In the fourth week there was a scattered attack of tobacco cutworm, *Prodenia litura* Fabr.[6] The attack became so severe in three days that hand-picking alone could not check the infestation. The pests were controlled after the plants were sprayed with DDT,[7] although hand-picking was continued whenever necessary.

The tobacco borer, *Gnorimoschema heliopa* Low.,[8] caused a large percentage of death. Mottling and curling of tobacco leaves was no-

[6] Determination by Dr. S. M. Cendaña of the Department of Entomology.

[7] The spray was recommended and supplied by Dr. G. B. Viado of the Department of Entomology.

[8] Determination by Dr. S. M. Cendaña.

ticed, but when the plants were taken to the Department of Plant Pathology, no indication of disease was found. Leafspot or frog-eye disease caused by *Cercospora nicotianae* Ell. and Evht.[9] was also rampant.

The greatest number of deaths in the first replication was found in treatment 1, the percentage reaching as high as 50 per cent. Deaths among the cultures irrigated with 2.05 liters, 4.10 liters, and 8.20 liters took place in the early part of the experiment. These deaths might have been due to the strain of transplanting since neither pest nor disease was found on the cultures.

In the second replication, the highest number of deaths (60 per cent) occurred in the plants irrigated with 8.20 liters which were attacked by the stem borer. The unirrigated plants and those irrigated with 2.05 liters, 4.10 liters, and 6.15 liters were affected less than the cultures which received 8.20 liters.

Weather observation. The weather observation from January to April, 1951, showed that a total precipitation of 9.9 centimeters occurred in 29 rainy days. The amount of rainfall for six days in April was 4.5 centimeters. This rain, which fell after the development stage of the plants, produced additional increase in height, but since the plants had already flowered, no additional leaves could have been borne although the size of the last few leaves and their weight might have been influenced.

During the period of observation, the minimum temperature ranged from 21.4°C. to 23.8°C. and the maximum, from 25.4°C. to 33.7°C. The average temperature ranged from 22.22°C. to 33.7°C., and the relative humidity, from 70.1 to 81.6 per cent.

Water requirement. The growth, yield, and size of leaves of filler variety of tobacco were influenced by the amount of irrigation and the interval of application. In addition to the rainfall of 9.9 centimeters which fell during the crop season, irrigations of 4.10 to 8.20 liters, or 20 to 40 per cent of the water-holding capacity of the soil, air-dry basis, produced favorable growth and heavier and larger leaves. It was found that when small amounts of irrigation water were used, better yield and size of leaves were obtained with short application intervals. Similarly, heavier irrigations given at longer intervals produced better yield and size of leaves than those given at shorter intervals.

SUMMARY

1. Surface irrigation of 4.10 to 8.20 liters for each plant, or 4.41 to 8.82 hectare-centimeter a hectare, produced better growth of tobacco plants.

2. The plants grew taller as the amount of irrigation applied once every two days was increased from 2.05 to 6.15 liters to each plant (2.21 to 6.61 ha.-cm. a ha.). The tallest plants were pro-

[9] Determination by Dr. F. T. Orillo of the Department of Plant Pathology.

duced by applying 6.15 liters to a plant, or 6.61 hectare-centimeters a hectare, once every six days.

3. The highest yield of cured leaves was obtained when irrigation of 2.05 liters (2.21 ha.-cm. a ha.) was done once every two days; 4.10 liters (4.41 ha.-cm. a ha.), once every two days; 6.15 liters (6.61 ha.-cm. a ha.), once every eight days; and 8.20 liters (8.82 ha.-cm. a ha.), once every ten days. These results show that tobacco plants give better yield when light but frequent irrigation or heavy but less frequent application is used.

4. Heavier irrigation (6.16 to 8.20 liters, or 6.61 to 8.28 ha.-cm. a ha.) given at longer intervals from the third week to maturity apparently produced wider and longer leaves. Lighter irrigation (2.05 to 4.10 liters, or 2.21 to 4.41 ha.-cm. a ha.) gave shorter and narrower leaves. Unirrigated tobacco plants produced lower yield and narrower and shorter leaves than the irrigated plants.

5. The amount and frequency of irrigation did not influence the death of the tobacco plants as the deaths were caused by the tobacco cutworm, *Prodenia litura* Fabr., tobacco stem borer, *Gnorimoschema heliopa* Low., and the strain of transplanting.

6. The best yield of cured leaves was produced when each tobacco plant was irrigated with 73.8 liters of water (79.43 ha.-cm. a ha.), in addition to 9.9 centimeters of rainfall, and the temperature range was 21.4°C. to 33.7°C. and the relative humidity was 70.1 to 81.6 per cent.

A FURTHER STUDY OF THE BREEDING HABITS OF CATTLE[1]

LOURDIO L. CLAMOHOY

The importance of a knowledge of the breeding habits of cattle for the proper care of these animals prompted this further study conducted in the Department of Animal Husbandry from July, 1949, to September, 1950.

MATERIALS AND METHODS

The names, ages, and breeds of the animals used in the experiment are tabulated below:

Bulls

NAME	AGE	BREED
Blueblood	5 yrs., 4 mos.	Nellore
Diamond Domino 89th	8 yrs., 3 mos.	Hereford
Los Baños	8 yrs., 4 mos.	Philippine
Survivor	5 yrs., 4 mos.	Philamin
Makisig's son (vasectomized)	2 yrs., 6 mos.	Grade Red Sindhi
Average	5 yrs., 11 mos.	

Cows

Bonkalot	6 yrs.	Philippine
Luta	7 yrs.	Philippine
Malva	5 yrs., 11 mos.	Philippine
Mara	3 yrs., 6 mos.	Philippine
Maraway	6 yrs.	Philippine
Minda	6 yrs., 11 mos.	Philippine
Palsara	7 yrs.	Philippine
Sampaguita	about 4 yrs.	Philippine
Bonacia	6 yrs.	Philamin
Gumamela	about 3 yrs.	Grade Red Sindhi
Jasmin	about 3 yrs.	Grade Red Sindhi

The breeding bulls were individually tethered in the Department of Animal Husbandry. They were watered morning and afternoon.

The vasectomized grade Red Sindhi bull was used for detecting oestrus in the cows because he was active and aggressive though incapable of fertilization. His semen was free from sperms. The semen of the other bulls was fertile. Diamond Domino 89th, Blueblood, and Survivor had produced offspring and Los Baños had normal, viable sperms.

The cows received similar treatment. They were rotated in three pastures accessible to a creek. Those which gave birth were separated from the herd and tethered so as to facilitate

[1] Central Experiment Station Contribution No. 1648. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1950. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

closer observation. Cows which were bred were returned to the herd.

The animals were observed daily from 6:00 to 7:00 o'clock in the morning and from 4:00 to 6:00 o'clock in the afternoon. To determine the length of coital period in an oestrus during which a cow may be bred, the bull was placed with the cow two or three days before the expected recurrence of oestrus. The bull's persistent following of the cow wherever she went was considered a sure sign of approaching oestrus in the cow. The first time the cow permitted coition was considered the onset of the coital period in the oestrus, and the last coition, after which the cow persistently refused to receive the bull, was taken as the end of the period. When the period of oestrus was long, the breeding bull was replaced with the vasectomized bull to determine the duration of oestrus. The interval between oestruses was determined by allowing natural mating without fertilization with the vasectomized bull. The length of time between the first mating in an oestrus and the first mating in the following oestrus was taken as the interval between oestruses.

The position and color of the cervix, the color of the mucosa of the vagina, and the consistency of the vaginal mucus of cows in oestrus were noted.

The signs of pregnancy were determined by the biweekly weighings of the pregnant cows from the time of mating and by the biweekly measurements of the barrel.

The behavior of the cow before, during, and immediately after parturition was observed.

DISCUSSION OF RESULTS

Interval between calving and first oestrus. The interval between calving and the first appearance of oestrus in the Philippine cows ranged from 42 to 151 days. In four of the five cows the first oestrus was within 79 days after calving; the average interval was 80.2 days. In the lone Philamin cow the interval was 152 days. The average interval in all the cows was 116.1 days, which is eight days longer than the average of 108 days found by Manresa and Diapo [2] and 26 days longer than the maximum period of 90 days mentioned by Rice.[3]

Signs of oestrus. The symptoms of oestrus common to all the cows studied were swelling of the vulva, vaginal discharge of mucus, raising of tail, frequent discharge of urine in small amounts, and restlessness. In some cows, mounting other animals and loss of appetite were observed. One of the cows in oestrus defecated frequently in small amounts, and another showed a small smear of

[2] MANRESA, M., AND DIOSCORO DIAPO. 1933. Studies on the breeding habits of cattle. Philippine Agriculturist 26: 870–891.

[3] RICE, V. A. 1942. Breeding and improvement of farm animals. xx + 750 p. New York and London: McGraw-Hill Book Company, Inc.

blood on the posterior surface of the left thigh just below the ischial region, similar to those found by Manresa and Diapo [4] and by Rice.[5]

Length of mating period during oestrus. The mating period began when the cow in oestrus first accepted coition and ended with the last coition in the oestrual period. The duration of the mating period during oestrus in Philippine cows ranged from 5.5 to 22.4 hours; the average was 11.3 hours. In the two grade Red Sindhi cows the average was 15.4 hours. The average duration for all the cows was 13.3 hours.

Interval between oestruses. The recurrence of oestrus among the unimpregnated cows ranged from 18 to 22.5 days. The average was 20.6 days among the Philippine cows, 20.2 days among the grade Red Sindhi cows, and 20.6 days in the Philamin cow. The average interval of 20.4 days for all the cows is similar to Manresa and Diapo's [6] reported interval of 20 days.

Behavior of cow and bull at mating time. At mating time the cow manifested frequent urination, bending of the loin (lumbo-sacral articulation) when the bull licked her vulva, raising of the tail, smelling of the sheath of the bull after coition, followed by raising of the head and eversion of the upper lip, and acceptance of the bull. Restlessness, running during coition, mounting other cattle irrespective of age or sex, rubbing against and licking the body of the bull, and approaching the bull were shown by some of the cows. Grazing, allowing the calf to suck, and grunting during coition were less common manifestations.

The licking of their own vulva was observed in the two grade Red Sindhi cows and in one Philippine cow. Goring the bull and jumping in a playful manner when she was near the bull were exhibited by one Philippine cow. Jerky movement of the muscles between the anus and the vulva and stretching and lowering of the back were also noted in one Philippine cow.

During mating time the bulls approached and chased the cows in oestrus, smelled and licked the vulva of the cow, raised the head and everted the upper lip, paused before protrusion of the penis, protruded the penis, passed droplets of urine from the erect penis before mounting and coition, passed small amounts of watery feces frequently, and drove away the cows not in oestrus. Faint grunting and stretching of the tail prior to mounting were noted in the Philamin and Hereford bulls.

Coitive capacity of bulls. Manresa and Diapo [7] noted that during the oestrual period the cow accepted only one service; very rarely did she accept two services. The number of coitions that a bull effected with a cow in oestrus ranged from two, with the Nellore bull, to seven, with the Philippine bull. The average num-

[4] Manresa and Diapo, *op. cit.*
[5] Rice, *op. cit.*
[6] Manresa and Diapo, *op. cit.*
[7] *Ibid.*

ber with the Hereford bull was 3.3 and with the Philippine bull, 5.3. The Nellore bull effected two coitions and the Philamin, three, with their respective mates. On the average, all the bulls effected 3.4 coitions with a cow in oestrus.

The interval between coitions lasted from 24 to 97.5 minutes. With the Philippine bull the average was 57.9 minutes and with the Hereford bull, 62.4 minutes. The Nellore bull had an interval of 24 minutes and the Philamin bull, 15.9 minutes. The average interval between coitions of all the bulls was 40.1 minutes.

The average period of coition for each bull was 0.85 to 2.3 seconds. It was 0.95 second for the Nellore bull, 1.36 seconds for the Philippine bull, 1.7 seconds for the Philamin bull, and 1.96 seconds for the Hereford bull. On the average, coition lasted 1.49 seconds.

The interval from the time the bull persisted in following the cow until initial coition ranged from one to eight hours; the average was five hours. In all cases, the bull mounted the cow even after oestrus had ended, but the latter refused to cooperate. The bulls stayed with their mates from one hour to six hours after oestrus, after which they lost interest and left the cows.

Condition of vulva and vagina of cow in oestrus. The vulva of the cow, except that of Malva, which appeared shrivelled, was swollen during oestrus. The mucous membrane of the vagina was pinkish red, the vaginal mucus was slimy, and the cervix was pinkish red and slightly open.

Manresa and Diapo [8] reported that the vaginal mucosa in closely confined animals is dark in color and that when such a sign appears with other symptoms, coition occurs. Rice [9] stated that the cervix relaxes, the mucus liquefies, and the vulva swells when the cow is in oestrus.

Signs of pregnancy. The position of the cervix and the condition of the vaginal mucosa during the first five months of pregnancy were studied. As usual, the cervix o fa pregnant cow was pale pink, whereas that of a cow in oestrus was pinkish red. The position of the cervix was not permanent, except in the two grade Red Sindhi heifers whose cervices were close to the vaginal floor. The os uteri was always closed. No adhesive cervical seal found by some authors was noticed. The mucus was sticky.

Manresa and Diapo [10] observed an improvement in the condition of the animal as pregnancy progressed. The writer noted a change-in-weight tendency in the impregnated cows. All of the cows, regardless of the time of the year, lost weight after impregnation or mating. This tendency lasted from the sixth to the twelfth

[8] *Ibid.*
[9] Rice, *op. cit.*
[10] Manresa and Diapo, *op. cit.*

week after impregnation and was followed by a steady gain in weight. The circumference of the barrels of the cows consistently increased after impregnation.

Signs of parturition. Manresa and Diapo [11] reported the appearance of mucoid secretions and the enlargement of the external genitalia and the udder as signs of approaching parturition. Other writers noted depression of the rump and of the region under the base of the tail. Rice[12] reported relaxation of the pelvic region, raising of the tail, formation of hollows in the flanks and rump, and dropping of the enlarged abdomen. Similar signs were noted by the writer.

Maraway was observed for 26 days and Bonkalot, 33 days before parturition. Bonkalot showed mucus discharges five times before delivery. The first discharge appeared 30 days before parturition and the second, three days later. At that time, the mucus hung about 30 centimeters from the vagina. The third mucus discharge was 12 days, the fourth, seven days, and the fifth, two days before parturition. On the last time, the vulva and udder were slightly enlarged. Small depressions on each side of the rump and under the base of the tail were noted. The pelvis appeared expanded. A few hours before delivery, the depression of the rump became deeper, the udder was distended further, and the vulva protruded, leaving the anus drawn as the abdomen dropped down and the back sagged.

Maraway had mucus discharges five times before delivery. The first discharge occurred 12 days before parturition; the second, nine days; the third, eight days; the fourth, four days; and the fifth, on the day of parturition. Seventeen days before delivery, the udder was slightly swollen. Sixteen days before parturition, the vulva was markedly pointed. Eight days before parturition, the vulva and the udder were significantly swollen. Depressions on the rump and under the base of the tail appeared two days before delivery. The pelvis was expanded. A few hours before parturition, the depressions of the rump became deeper, the udder became fully distended, the vulva protruded, causing the anus to recede inward. The abdomen was low and the back swayed.

Behavior of cow and calf during and immediately after calving. Immediately before parturition, fetal movements on the sides of the abdomens of Maraway and Bonkalot were noted. These movements made the skin on the right hind flank of Maraway react violently. Her hind legs were alternately raised slightly from the ground. She licked her rear flanks. Both Maraway and Bonkalot were gentle at this time.

When labor pains set in, Bonkalot became uneasy and did not graze. She switched her tail, moved around and grunted, and at times lay down. A copious amount of fluid was discharged when the fetal membranes burst 28 minutes before delivery. Bonkalot

[11] *Ibid.*
[12] Rice, *op. cit.*

licked the fluid and ate the tissues. The fetal membranes hung out, and the forelegs of the fetus appeared. The back of the cow was now curved upward and the hind legs were far apart to facilitate the expulsion of the fetus. When the forelegs of the young were out until the knees, the cow was uneasy; she moved around and grazed here and there. Then she lay down on the left side, and in this position the fetus was expelled in six minutes.

Immediately after delivery, the cow stood up, grunted repeatedly, and licked the membrane that extended from the muzzle to the forelegs of the calf which lay flat on its right side on the ground, its legs stretched out. It took the cow 33 minutes to do this. The cow swallowed the navel cord, together with other fetal membranes of the calf, 32 minutes after calving.

The calf breathed even while it was still inside the fetal membranes. In Bonkalot's calf, the membrane covering the nostrils bulged out during exhalation. As the calf lay on the ground, it tried to raise its head, then to move its ear which was away from the ground. After the mother had licked it the calf shook its head. The newborn calf attempted to rest on its breast and abdomen with its head raised. While licking the calf, the dam yawned.

Twenty-two minutes after parturition Maraway's calf tried to stand up; it was able to do so 53 minutes after delivery. Bonkalot's calf made its first attempt to stand up 23 minutes after parturition and succeeded 36 minutes after delivery. Maraway helped her calf stand by prodding it lightly with her muzzle, but Bonkalot did not. In its first attempt to stand up, the calf knelt and then rose on its hind legs. The calf stood with forelegs wide apart to brace itself; then it walked slowly towards the dam.

The first instinct of the calf after standing was to look for the udder of the dam. The calf went first to the foreflanks of the dam and commenced the search for the udder with difficulty. It took 58 minutes for Maraway's calf to locate and suck its dam's udder and 44 minutes for Bonkalot's calf. In the course of sucking, the meconium dropped, 59 minutes after birth for Maraway's calf and 52 minutes for Bonkalot's calf. The first sucking of Maraway's calf lasted for 24 minutes; that of Bonkalot's calf, 26 minutes. Apparently, there was enough milk in the udder of Maraway for succeeding suckings until 4 hours and 26 minutes after birth. The calf bumped the udder to stimulate milk secretion. With Bonkalot's calf, stimulation took place 2 hours and 59 minutes after parturition. Afterwards the calf played, ran, or walked slowly around the dam. It sucked and lay down to rest while the dam grazed.

The placenta or afterbirth of Maraway started to drop 2 hours and 26 minutes after the expulsion of the fetus. It finally fell to the ground 2 hours and 32 minutes after delivery, or six minutes after it started to drop. While the afterbirth was hanging from the vagina, the cow reached for it and ate it in 30 minutes, even after

it had dropped to the ground. The afterbirth of Bonkalot was out 5 hours and 2 minutes after the expulsion of the fetus.

The duration of parturition of Maraway, that is, from the bursting of the fetal membranes to the dropping of the afterbirth, was 3 hours and 7 minutes; that of Bonkalot, 5 hours and 30 minutes. The average was 4 hours and 18.5 minutes.

SUMMARY

1. A study made on eleven cows, four bulls, and one vasectomized grade Red Sindhi bull showed that oestrus appeared 42 to 152 days after calving, or after an average of 116.1 days. The recurrence of oestrus ranged from 18 to 22.5 days; the average was 20.4 days. The oestrual period during which the cows allowed themselves to be covered by the bulls ranged from 5.5 to 22.4 hours, or an average of 13 hours.

2. The important signs of oestrus were raising of the tail, frequent urination, passing out of mucoid substance, swelling of the vulva, and restlessness. Mounting of other cattle and loss of appetite were infrequent. The genitalia of the cow exhibited swollen vulva, pinkish red and congested vagina, slimy mucus in the vagina, and pinkish red and open cervix lying on the floor of the vagina. The udder was also swollen.

3. At mating time the cow manifested frequent urination, bending of the loin (lumbo-sacral articulation) when the bull licked her vulva, raising of the tail, smelling of the sheath of the bull after coition, followed by raising of the head and eversion of the upper lip, and acceptance of the bull. The bull chased or approached the cow, smelled and licked the vulva, raised his head and everted his upper lip, paused before the protrusion of penis, exhibited jerky movements of the muscles of the ischial arch below the anus, passed droplets of urine, protruded penis before mounting and coition, passed small amounts of watery feces frequently, and drove away cows not in oestrus.

4. All the cows accepted two or more coitions during an oestrus. During oestrus a bull performed an average of 3.4 services. The average interval between coitions was 40.1 minutes, and the average duration of a single coition was 1.49 seconds.

5. The signs of pregnancy were pale pink and closed cervix, sticky vaginal mucus and pale pink vaginal mucous membrane, and passing out of mucus at later stages of pregnancy as early as 30 days before parturition. The cows lost weight up to the sixth or twelfth week after impregnation, after which they steadily gained in weight. The circumference of the barrels of the cows increased after impregnation.

6. The signs of parturition were intermittent vaginal mucous discharge about 15 days before delivery, swelling of the vulva and udder 8 to 12 days before parturition, deep depression of rump and base

of the tail two days before delivery, and deep sagging of abdomen and back a few hours before parturition.

7. Labor pains were manifested by uneasines and switching of the tail. About half an hour before calving, the fetal membranes burst and emitted copious watery fluid. This was followed by the birth of the fetus while the dam was lying on the ground. The dam at once licked the calf from the nostrils to the rear and helped it stand up. After standing, the calf searched for the udder and sucked. The placenta was dropped on an average of 3 hours and 17 minutes after delivery. Parturition lasted 4 hours and 18.5 minutes.

PHYSICAL PROPERTIES OF FIBERS FROM DIFFERENT LEAF SHEATHS OF AN ABACÁ STALK [1]

SOTERO I. ALBANO, JR.

WITH TWO TEXT FIGURES

A study of the physical properties of fibers from different leaf sheaths of an abacá stalk was made in the Fiber and Oil Division of the Department of Agronomy, College of Agriculture, Los Baños, Laguna, from November, 1950, to March, 1952.

According to Fiber Inspection Administrative Order No. 4 (revised), three important physical properties determine the grading of abacá fiber for export, namely, tensile strength expressed in breaking length,[2] color, and cleaning. In addition, texture and length identify the type of fiber in any of the grades. In determining and comparing the tensile strength expressed in breaking length, the color, the length, and the amount, as influenced by the position of the leaf sheaths on the stalk, of fibers from the different leaf sheaths of a mature abacá stalk, only fiber of excellent cleaning was considered, that is, fiber with very little or no pulp attached to it.

MATERIALS AND METHODS

The variety of abacá used in this study was *Musa textilis* Neé var. *Maguindanao* (Saleeby), which is described by Vista [3] as follows:

> This variety produces 10–17 plants to a hill but 4–5 are medium and 4–8 are small, spreading in a hill; is a fast grower, begins flowering at the age of one year and 4½ months after the sucker is transplanted; of lowland habitat. The false stem is 3.30–4.30 m. high, 20–22 cm. in diameter at the enlarged base and 8–12 cm. in diameter at the top. This grows into a very big plant; as tall as 5.5 m. if planted on rich alluvial soil. It flowers when only 2.5 m. high if grown in heavy soils.

A native "hand-hagutan" was used to extract the fiber (fig. 1). The stripping apparatus consists of two cross-pieces of wood, one vertical and the other horizontal. The horizontal piece, with the prescribed smooth-edged knife on one end and an 18-kilo weight on the other end, passes through a rectangular hole in the vertical piece, on which is a bolt that serves as fulcrum. When not in use, the knife is held down by a block of wood fixed to the vertical piece.

---

[1] Central Experiment Station Contribution No. 1649. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of Associate Professor Pedro A. David.

[2] The minimum length of a fiber in kilometers that will break under its own weight.

[3] VISTA, T. I. A study of the classification of abacá varieties. (Thesis presented for the degree of Master of Science from the College of Agriculture, 1920. Unpublished).

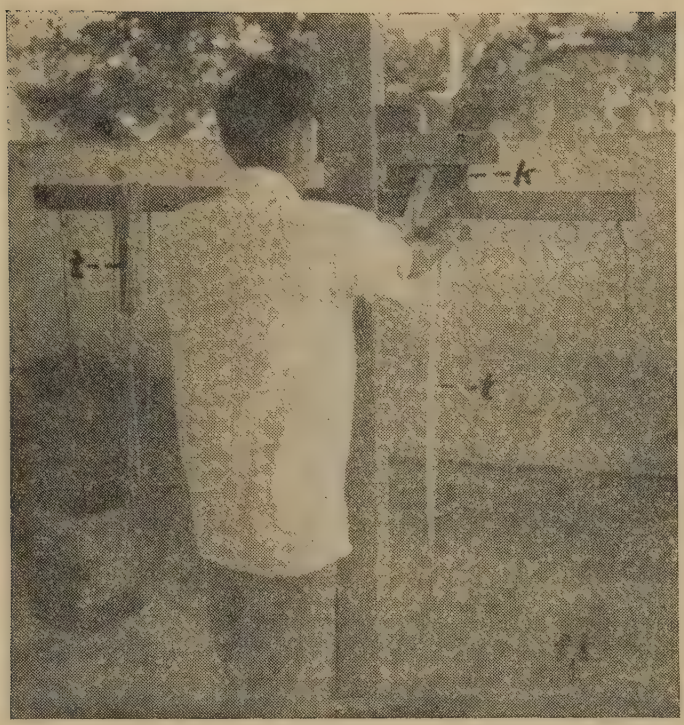

Fig. 1.—Extraction of fiber from a leaf sheath of abacá with a native "hand-hagutan" showing (k) knife, (t) "tuxy," (ft) foot treadle, and (w) weight. (*Photographed by Dr. Julian Banzon*)

To determine the breaking load of fiber, a Scott Testers IP-2 Tensilgraph machine was used (fig. 2). This machine is mounted on a level position on a strong table and operates at a 25° inclination of the tilting beam. The automatic reverse is regulated by the dog on the gear rack. To reverse the tilting beam, that is, to return it to its starting position, the trip lever which holds the bell crank starting lever in the running position is pressed down. The motor itself is controlled by a safety switch which automatically moves to the "off" position in the event of an overload. A flexible cord and conventional plug connects the machine to the electric current. The machine is provided with a motor drive running through a gear reduction and a gear box driving shaft, to which is attached a positive drive clutch which engages with a similar clutch attached to the rack driving gear.

A mature abacá plant was harvested. The leaf sheaths of the stalk were detached and weighed separately after the diameter of

the top and enlarged base and the length and weight of the whole stalk were noted.

To prepare the "tuxies," the sharp point of a specially designed knife was inserted through each of the overlapping leaf sheaths to facilitate the removal of two- or three-inch pieces of the outer fiber-containing layers. Three to four "tuxies" were made from each leaf sheath with good fibers.

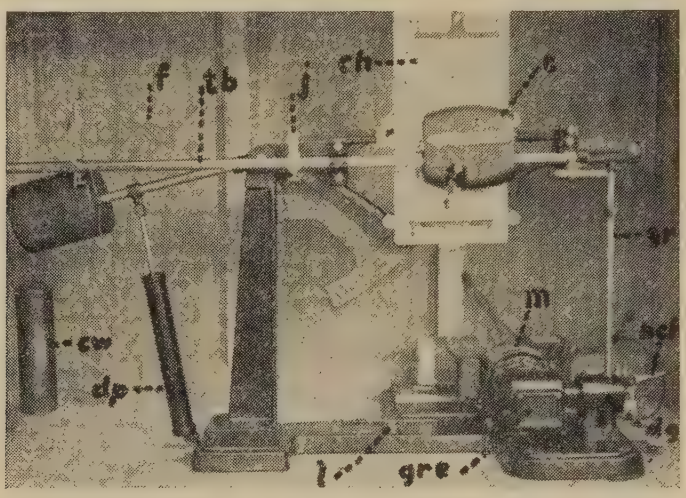

Fig. 2.—The Scott Testers IP–2 Tensilgraph machine, used to determine the breaking load of abacá fiber from each leaf sheath, showing (f) single fiber strand, (tb) tilting beam, (j) jaw, (ch) chart, (c) carriage, (cw) counter weight, (dp) dash pot, (l) spirit level, (gre) gear reduction box, (m) motor, (dg) rack driving gear, (bch) bell crank handle, and (gr) gear rack. (*Photographed by Dr. Julian Banzon*)

In extracting the fiber with the "hand-hagutan," the foot treadle was pressed with the right foot to lower the blade with a slight tipping at the outer end in order to facilitate the insertion of the "tuxy." When the "tuxy" was in place, the foot treadle was released. The other end of the "tuxy" was wound around a short piece of wood which the stripper pulled with a uniform motion until the length of the "tuxy" had passed the blade. The portion of the "tuxy" wound around the wood was then subjected to the same treatment. The cleaned fiber was hung to dry. Precaution was taken so that the fibers from the different leaf sheaths were not mixed.

The fibers were weighed on a platform balance for their dry weight and were measured with a meter stick for their length. The color was determined by comparing the extracted fibers with the

government standard samples obtained from the Fiber Inspection Service in Manila.

Single-fiber strand samples from the base, middle, and top sections of the different leaf sheaths were prepared. Forty-five trials for each leaf sheath and fifteen for each section were made.

After the tensile strength machine had been checked for operation, a 2000-gram chart was inserted in the machine, such that the lower end of the chart rested on the stop pins. The pen was adjusted so that the pen point coincided with the zero mark of the chart. The fiber sample was then fastened to the two jaws adjusted five centimeters apart. A two-kilo carriage was used. The machine was started by pushing down the bell crank handle on the right hand side of the gear box. When the fiber broke, the breaking load registered on the chart was noted. The broken fibers were cut close to the sides of the jaws by a sharp razor blade and weighed in an analytical balance. This operation was repeated until the required number of trials was completed.

In accordance with Botkin, Shires, and Smith,[4] the tensile strength of fiber expressed in breaking length was computed from the following formula:

$$\textit{Tensile strength} = \frac{\textit{Breaking load}}{\textit{Weight of sample per centimeter}}$$

RESULTS AND DISCUSSION

In this experiment, the leaf sheaths were grouped according to the four divisions made by Saleeby:[5] the outside sheaths (*babá*), sheaths next to the outside (*segunda babá*), middle sheaths, and inner sheaths (*ubud*), referred to in this paper as groups I, II, III, and IV, respectively. In the process of "tuxying," sheaths 1 to 5 were considered under group I, 6 to 11 under group II, 12 to 18 under group III, and 19 to 23 under group IV.

Tensile strength. Table 1 shows the tensile strength in kilometers of the fibers of the different leaf sheaths. Fibers obtained from group II (sheaths 6 to 11) were found highly significant in tensile strength over those from the other groups. Espino[6] explained that the brittleness of the fibers from the outside sheaths is due to the excessive amount of stegmata, and the weakness of the strands from the innermost sheaths is due to the undeveloped cell walls. It was further noted that the difference in tensile strength between the fibers from sheaths 12, 13, 14, and 15 of group III and those from sheaths 1, 2, 3, and 4 of group I was highly significant in favor of

[4] Botkin, C. W., L. B. Shires, and E. C. Smith. 1943. Fiber of native plants in New Mexico. New Mexico Agric. Exper. Sta. Bull. 300: 1–38. *Fig. 1–12.*

[5] Saleeby, M. M. 1930. The standard grades of abacá. Fiber Standardization Board Bull. 1: 1–47. *Pl. 1–19.*

[6] Espino, R. B. 1916. Abacá fiber. The Philippine Agriculturist and Forester 4: 200–216. *Pl. 1–5.*

group III. Fibers of group IV, however, were significantly weaker than those of group I. The results obtained show distinct differences in tensile strength among the different groups.

Table 1 further shows that the fibers from the base and middle sections of the leaf sheaths were stronger than those from the top portion. The difference was highly significant.

Weight. Group II yielded the most fiber. The mean weight of group II was 24.4 ∓ 0.537 grams; that of group III, 21.9 ∓ 1.501 grams; and that of group I, 19.4 ∓ 1.174 grams. Group IV, with a mean weight of 9.9 ∓ 2.447 grams, gave the least amount of fiber. The discrepancy in weight may be due to the fact that a great portion of the weak inner sheath fibers was cut and included with the pulp in the process of stripping. Statistically compared, the mean differences in weight between group IV and groups I, II, and III were highly significant (table 2). Group II was highly significant over group I but insignificant over group III.

Color. Saleeby, in 1930, reported that the natural color of abacá fiber is influenced by the color of the leaf sheath from which it was extracted and by the manner of its extraction or cleaning. The true color is apparent only in fibers of excellent cleaning. In this study, the color ranged from dull brown in the fibers of the outside sheaths to almost white in those of the inner sheaths.

Length. Fibers from group III, with a mean length of 268.5 ∓ 10.730 centimeters, were the longest. Those from group II, with a mean length of 235.8 ∓ 6.380 centimeters, were next. Groups I and IV produced the shortest fibers. The mean lengths of the fibers from groups II and III were longer than those from groups I and IV. Table 2 shows that the differences were highly significant.

The highest mean percentage of extraction (based on dry-fiber weight) was 1.51, which was obtained from group I. The mean percentages of extraction for groups II, III, and IV were 1.40, 1.12, and 0.70, respectively.

SUMMARY

1. According to tensile strength, the fibers from the different groups of leaf sheaths of an abacá stalk ranked as follows: those from sheaths next to the outside (6 to 11), first; those from middle sheaths (12 to 18), second; those from outside sheaths (1 to 5), third; and those from inner sheaths (19 to 23), last.

2. Fibers from the base and middle sections of the leaf sheaths were stronger than those from the top portion.

3. Sheaths next to the outside, middle sheaths, and outside sheaths produced more dry fiber than the inner sheaths. The difference in mean fiber weight between the inner sheaths and any of the other groups was highly significant.

4. As to mean length of fiber, middle sheaths (12 to 18) ranked first; sheaths next to outside (6 to 11), second; and outside (1 to 5) and inner (19 to 23) sheaths, last.

TABLE 1

Tensile strength in kilometers of the different leaf sheaths of an abacá stalk (var. Maguindanao)

GROUP	LEAF SHEATH	SECTION	TRIAL															TOTAL	MEAN
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
I	1	Base	47	41	42	61	64	63	58	51	65	59	48	40	52	62	54		
		Middle	60	60	51	49	43	64	36	55	43	58	38	61	47	55	51		
		Top	38	44	34	34	33	46	71	61	61	69	41	32	41	61	70	2,314	51.4
	2	Base	47	53	43	40	40	54	40	46	41	43	47	43	43	44	49		
		Middle	40	48	50	66	48	39	53	47	49	61	49	54	54	37	50		
		Top	56	50	34	54	64	44	63	43	42	64	49	62	62	55	41	2,201	48.9
	3	Base	50	46	44	40	60	48	46	47	49	59	55	51	52	51	52		
		Middle	47	40	43	47	40	43	63	57	49	49	49	54	53	45	51		
		Top	45	39	43	38	55	58	60	55	57	40	53	59	42	44	46	2,214	49.2
	4	Base	50	44	52	47	45	44	65	57	48	47	59	64	57	53	55		
		Middle	42	42	51	47	64	58	70	62	63	58	53	42	51	41	55		
		Top	51	51	38	44	36	51	40	42	61	31	39	51	50	56	63	2,290	50.9
	5	Base	70	56	55	61	74	57	82	65	88	57	85	64	56	64	74		
		Middle	62	61	52	68	69	58	83	73	86	86	46	80	52	41	47		
		Top	47	61	46	50	53	49	63	75	55	69	66	54	61	70	55	2,846	63.2
II	6	Base	70	57	64	72	69	73	84	85	68	73	86	72	61	84	85		
		Middle	69	88	71	69	63	57	85	61	57	81	61	65	77	61	55		
		Top	57	51	77	66	76	70	75	63	60	70	67	68	72	58	73	3,126	69.5
	7	Base	69	61	64	69	72	63	80	63	73	68	83	54	75	66	66		
		Middle	60	81	69	79	73	75	65	74	53	81	73	68	56	76	59		
		Top	67	63	59	57	40	75	80	69	76	60	73	59	69	79	53	3,047	67.7
	8	Base	56	67	65	86	75	70	64	73	69	82	63	63	85	56	87		
		Middle	74	74	72	86	75	70	80	71	86	70	63	71	70	70	71		
		Top	58	80	73	62	60	71	62	62	69	67	66	63	85	87	64	3,193	71.0
	9	Base	83	77	72	74	71	64	70	81	87	77	79	78	86	74	80		
		Middle	76	90	80	83	86	96	80	91	81	73	68	72	63	70	69		
		Top	57	86	61	83	76	63	73	80	71	72	81	81	78	53	63	3,409	75.8
	10	Base	71	85	65	63	73	86	86	79	81	77	72	87	68	73	80		
		Middle	94	70	85	78	90	67	89	99	97	97	84	78	69	88	88		
		Top	97	69	82	85	75	69	63	78	68	68	61	85	75	77	75	3,546	78.8

TABLE 1 (continued)

GROUP	LEAF SHEATH	SECTION	TRIAL															TOTAL	MEAN
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
III	11	Base	64	95	85	70	85	68	70	87	90	68	85	88	89	85	89		
		Middle	88	70	58	71	79	93	80	59	69	82	80	93	75	81	81		
		Top	94	69	98	98	89	79	77	70	75	88	70	83	85	66	70	3,588	79.7
	12	Base	81	83	80	79	83	67	75	75	67	72	80	74	81	75	70		
		Middle	83	70	77	76	72	64	83	70	85	76	81	77	91	70	76		
		Top	60	70	83	82	83	70	63	79	65	64	78	72	75	75	60	3,372	74.9
	13	Base	82	59	68	59	60	52	79	83	54	83	75	72	76	65	60		
		Middle	74	75	76	64	51	51	52	56	63	84	77	57	79	63	69		
		Top	62	58	66	62	78	59	61	61	63	54	66	65	74	60	50	2,957	65.7
	14	Base	64	68	66	51	51	55	72	55	73	57	50	57	59	60	54		
		Middle	61	55	78	77	68	73	63	71	57	78	59	78	59	50	61		
		Top	61	63	66	58	63	50	61	53	45	66	60	64	64	45	57	2,756	61.2
	15	Base	51	50	49	59	46	63	67	46	51	56	52	49	58	51	65		
		Middle	62	74	63	53	43	61	58	56	64	53	71	72	47	61	71		
		Top	58	55	59	69	77	65	66	74	83	54	44	57	47	48	49	2,627	58.4
	16	Base	37	44	42	36	36	34	36	54	57	51	54	57	54	60	65		
		Middle	41	49	40	37	43	54	54	56	44	46	50	44	43	43	47		
		Top	49	42	54	49	35	50	58	49	55	48	49	43	54	47	39	2.129	47.3
	17	Base	38	54	54	54	47	47	45	42	38	45	41	46	43	50	49		
		Middle	58	49	47	33	58	34	44	40	49	49	49	30	50	46	48		
		Top	36	40	57	39	50	40	38	33	37	48	48	34	49	60	48	2.634	45.2
	18	Base	48	37	40	34	39	47	51	37	54	41	47	35	50	40	35		
		Middle	49	53	45	46	46	40	39	42	38	50	41	44	48	49	41		
		Top	43	41	38	51	38	51	36	46	40	50	51	42	30	40	42	1,945	43.2

(TABLE 1 (continued)

GROUP	LEAF SHEATH	SECTION	TRIAL															TOTAL	MEAN
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
IV	19	Base	49	43	43	35	34	50	54	42	31	36	30	38	44	42	50		
		Middle	43	45	47	36	53	34	31	37	49	33	39	49	30	37	52		
		Top	45	34	44	39	31	33	29	32	48	40	32	41	54	35	36	1,809	40.2
	20	Base	50	41	43	51	39	36	51	49	42	38	34	53	37	46	52		
		Middle	30	37	34	33	39	29	38	49	41	31	34	31	38	42	28		
		Top	32	36	31	34	36	38	36	29	34	29	36	29	37	35	33	1,701	37.8
	21	Base	38	30	39	36	40	33	33	28	31	32	35	33	30	29	30		
		Middle	29	30	30	28	26	30	30	27	30	37	29	34	30	31	31		
		Top	38	35	24	36	35	29	30	32	31	30	33	24	24	29	29	1,408	31.3
	22	Base	35	41	38	30	29	31	32	32	35	37	28	27	29	33	31		
		Middle	33	42	30	23	32	22	33	40	42	41	32	44	29	28	25		
		Top	33	31	27	30	29	34	27	38	27	28	36	36	33	31	22	1,446	32.1
	23	Base	39	34	32	33	28	21	24	39	35	33	33	23	20	30	29		
		Middle	33	35	30	29	38	26	32	32	34	41	18	20	30	25	19		
		Top	27	29	23	39	30	33	22	18	23	32	21	34	33	21	30	1,310	29.1
		Base																19,372	56.2
		Middle																19,408	56.3
		Top																18,488	53.6

Analysis of variance

SOURCE OF VARIATION	D. F.	SUM OF SQUARES	MEAN SQUARE VARIANCE	COMPUTED F	TABULAR F	
					5%	1%
Leaf sheath	22	248,707.24	11,304.87	105.21	1.58	1.89
Section	2	1,574.06	787.03	27.32	3.00	4.62
Leaf sheath × Section	44	4,727.90	107.45			
Sampling Error	966	41,988.13	43.47			
Total	1,034	296,997.33				

L.S.M.D.	(1% level)	(5% level)
Leaf sheath	3.666	3.065
Section	5.174	3.360

TABLE 2

Comparison of fibers obtained from the different groups of leaf sheaths of an abacá stalk (var. Maguindanao)

GROUPS COMPARED	CHARACTER	D ∓ ED	COMPUTED t	LEVEL OF SIGNIFICANCE		REMARKS
				5%	1%	
II—I	Dry weight	5.0 ∓ 1.291	3.872	2.26	3.25	Highly significant
III—I		2.5 ∓ 1.908	1.310	2.23	3.17	Not significant
I—IV		9.5 ∓ 2.714	3.503	2.31	3.36	Highly significant
II—III		2.5 ∓ 1.568	1.568	2.20	3.11	Not significant
II—IV		14.5 ∓ 2.505	5.788	2.26	3.25	Highly significant
III—IV		12.0 ∓ 2.870	4.181	2.23	3.17	Highly significant
II—I	Length	51.8 ∓ 10.686	4.847	2.26	3.25	Highly significant
III—I		84.5 ∓ 13.725	6.156	2.23	3.17	Highly significant
I—IV		6.0 ∓ 17.420	0.344	2.31	3.36	Not significant
II—III		32.7 ∓ 12.483	2.619	2.20	3.11	Significant
II—IV		65.8 ∓ 16.452	3.999	2.26	3.25	Highly significant
III—IV		98.5 ∓ 18.577	5.302	2.23	3.17	Highly significant

INBRED LINE SELECTION IN YELLOW FLINT CORN [1]

RODOLFO C. YLARDE

Jenkins and Brunson (1932) have shown that the inbred-variety (open-pollinated) cross or topcross can be used efficiently in predicting the performance of the inbred lines in doublecrosses, multiple crosses, or synthetic varieties. This technique of evaluating the lines is known as the combining ability test. The combining ability is determined from the yield-capacity of the F_1 progenies of a topcross, and according to Johnson and Hayes (1936) and Hayes, Murphy, and Rinke (1943), inbreds of high combining ability are more likely to produce better single or doublecrosses than inbreds of low combining ability.

In November, 1951, from 195 S_3 lines derived from eight regional strains of Yellow Flint corn, 24 were selected for plant, ear, and grain characters; similarly, 24 lines were selected from 107 S_3 lines developed from South American varieties. The study was undertaken to evaluate by the combining ability test the performance in doublecross combinations of the 48 selected inbreds.

The investigation was conducted in the Plant Breeding laboratory of the Department of Agronomy, College of Agriculture Central Experiment Station, Los Baños, Laguna, from June, 1951, to March, 1952.

MATERIALS AND METHODS

Parental stocks of inbred lines of native Yellow Flint. One hundred ninety-five S_3 lines were obtained from the following regional strains: Pangasinan Yellow Flint, Bataan Yellow Flint, Laguna Yellow Flint, Albay Yellow Flint, Cebu Yellow Flint, Palawan Yellow Flint, Zamboanga Yellow Flint, and Agusan Yellow Flint.

One hundred seven foreign inbreds were developed from Cuban Yellow (Cuba), Urquiza (Mexico), Taberon (El Salvador), and Venezuelan Flint (Venezuela). These S_3 lines were produced by the Department of Agronomy.

Selecting the inbred lines. During the tasseling time in February, 1951, five S_3 lines were selected from each of the eight regional strains for their greenness, broadness and number of leaves, resistance to stalk and root lodging, height of the ear above the ground, resistance to damage by insects and diseases, and ability to shed plenty of pollen.

At harvest time the lines selected for desirable plant characters were then subjected to further visual selection based on the following

[1] Central Experiment Station Contribution No. 1650. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of Dr. Dioscoro L. Umali.

ear and grain characters: well-covered ear, cylindrical shape of ear, length of ear, number of grain rows, well-filled ear, and freedom from damage by insects and diseases.

Only three lines were selected from each regional strain, making a total of 24 S_3 lines for the native inbreds.

The same method of selection was used for the introduced South American inbreds. However, six lines were selected for each foreign strain, making a total of 24.

The 24 native inbreds finally selected for the topcross were Pangasinan—C 1-1, C 36-6, and C 41-1; Bataan—C 33-2, C 27-2, and C 35-2; Cebu—C 2-4, C 43-2, and C 20-2; Albay—C 15-5, C 8-7, and C 28-2; Palawan— C 9-3, C 5-3, and C 12-1; Agusan—C 42-1, C 3-2, and C 13-2; Laguna—C 14-1, C 17, and C 19-2; and Zamboanga—C 40-2, C 32-2, and C 34-4.

The 24 foreign inbreds were Cuban Yellow Flint—I 37-1, I 42-1, I 49-1, I 43-1, I 68-2, and I 15-3; Urquiza—I 70-3, I 59-2, I 30-1, I 8-3, I 76-3, and I 50-1; Taberou—I 38-1, I 65-3, I 60-1, I 75-2, I 86-6, and I 51-1; and Venezuelan Flint—I 96-2, I 9-1, I 99-1, I 69-2, I 71-2, and I 72-2.

Making the topcrosses. In the wet-season planting of 1951, a 30-hill row of each inbred was planted as pollen parent. For every two rows of inbreds, one row of the variety was planted as seed parent. Five selected plants of the variety were hand-pollinated with the pollen of the inbred. The tester for the native inbreds was the Cuban Yellow Flint, and for the introduced inbreds, the College Yellow Flint.

The bulked grains from the five ears of each topcross were used for the performance test.

Performance test of the topcrosses: Field plot design. The design used in this test was the balanced or symmetrical incomplete block which calls for (1) 25 lines (24 topcrosses plus one open-pollinated variety as check) to be tested, (2) six replications, (3) 30 blocks (five blocks to a replication), and (4) five plots to a block. Numbers corresponding to entries of the lines, the position of a line within a block, the blocks in a replication, and the replications in the field were randomized. Each plot had 12 hills 60 centimeters apart.

The analysis of the data as presented by Love (1943) was used.

Planting. On December 28, 1951, the 25 lines to be tested were planted. Five kernels were dropped to a hill and two weeks later, each hill was thinned to two plants. Guard rows were planted around every block to prevent any favorable growing conditions in border rows.

Field observations. At tasseling time, the following were observed: (1) height of ear from the ground, (2) number of leaves, (3) susceptibility to root and plant lodging, and (4) height of plants. Only the plants of replication D were used for determining the mean

height of plants, the height of ear from the ground, and the number of leaves. For each line, 20 plants were measured.

Observations after harvest. The harvested ears were dried to 15 per cent moisture before the shelling percentage and grain yield (based on harvesting ten perfect-stand hills) were determined.

RESULTS AND DISCUSSION

In plant breeding and testing, the experimenter is often faced with the problem of including a large number of varieties. Often, more than 20 strains need to be handled in a yield test, and if a block is sufficiently large to contain all the plots of every strain, the blocks become too large and the experiment, aside from being hard to handle, will not be as satisfactory as when the blocks are kept moderately sized. The incomplete block design, in which no single block contains every treatment and the blocks are kept small, was used in the present study. With this design, only 1,300 square meters of land was devoted to the testing of the 25 lines. Tables 1 and 2 show the mechanics of computation of the data for the performance of the native inbreds; tables 3 and 4, of the South American inbreds.

In table 5 the native inbreds are ranked according to their topcross yield. The first ten inbreds, whose yields ranged from 135.58 to 199.16 per cent of the yield of College Yellow Flint, were significantly better producers than the control; the next 13 inbreds, whose range in yield was 91.39 to 122.56 per cent, were as good as College Yellow Flint; and the last inbred, which yielded 73.63 per cent, was significantly a poorer grain producer compared with College Yellow Flint. That visual selection alone is not enough to appraise a given inbred is shown by the fact that though these lines were already selected for vegetative vigor, only 41.7 per cent proved to be of good combining ability.

Among the first ten inbreds which can be classified as good combiners, two were significantly taller and six had significantly more leaves than College Yellow Flint (table 5). There were, however, other lines with desirable agronomic characters but poor combining ability. A good example is line C 36-6.2 whose height, number of leaves, and shelling percentage were better than the control strains and yet was a poor combiner. Going by these results, it is evident that there is no direct relation between agronomic characters and combining ability of the lines.

As shown by the analysis of variance in table 4, there is no significant difference in the topcross yields of the South American inbred lines, indicating that none of these lines can be classified as good combiners. The introduced inbreds were damaged seriously by the leaf-cut worm (*Plusia chalcytes Esper.*), the stem borer (*Pyrausta nubilalis* Hubn.), the earworm (*Heliothis armigera* Hubn.), and the leaf miner (Agromyzid).[2]

[2] Determination by Dr. Silverio M. Cendaña of the Department of Entomology.

In combining ability tests, earlier generations of the inbreds, usually S_3 lines, are used. The finding of Jenkins (1935) that inbred lines showed their individuality as parents in topcrosses in the early segregating generations and remained relatively stable in later inbred generations led to the consideration of the value of testing the combining ability in the early generations of selfing. Singleton and Nelson (1945), who investigated further the conclusions of Jenkins, found that the potential combining ability of an inbred can be reliably recognized after three generations of selfing and will persist even if the selfing is carried on further. Lately, however, Wernham (1952), reasoning that a given number of lines maintain their relative positions from S_1 to S_4 generations with respect to blocks of favorable genes for yield, concluded that the testing of lines at S_0 level is as valid as any test done at later generations of inbreeding. From the genetic point of view, Wernham's assumption may be plausible, but from the plant breeder's standpoint, the implementation of his assumption would be difficult, especially if the lines are intended for the production of singlecross or doublecross hybrids. The difficulty lies in the maintenance of the selected lines. Since an early generation inbred has not yet assumed any stable characteristic or individuality, it will be hard to detect any contaminants, outcrosses, or off-types, and the line may become modified or lost in a few generations.

In the development of corn hybrids, concern is on the specific combining ability to which maximum yield in hybrid combinations is attributed and which can be recognized only in the later generations of inbreeding and not on general combining ability, which can be measured even on S_1 lines.

SUMMARY AND CONCLUSION

The combining ability of 24 S_3 lines derived from eight regional strains of the Philippines and 24 S_2 lines developed from four South American varieties was determined from the topcross performance of the lines.

1. Of the native inbred lines, ten were found to be good combiners. Grouped according to regional strains and the lines extracted from them, they are as follows:

a. C 15–5—150.38 per cent of C.Y.F.[3]—Albay strain
b. C 35–2—163.53 per cent of C.Y.F.—Bataan strain
c. C 27–2—140.27 per cent of C.Y.F.—Bataan strain
d. C 43–2—167.15 per cent of C.Y.F.—Cebu strain
e. C 20–2—150.25 per cent of C.Y.F.—Cebu strain
f. C 12–1—145.35 per cent of C.Y.F.—Palawan strain
g. C 1–1—199.16 per cent of C.Y.F.—Pangasinan strain
h. C 41–1—135.58 per cent of C.Y.F.—Pangasinan strain
i. C 40–2.1—188.99 per cent of C.Y.F.—Zamboanga strain
j. C 32–2—146.77 per cent of C.Y.F.—Zamboanga strain

2. Not one of the 24 S_3 lines from South America was found to be a good combiner. The lines were susceptible to insect damage.

[3] College Yellow Flint.

LITERATURE CITED

HAYES, H. K., AND E. H. RINKE. 1943. A comparison of the actual yields of doublecrosses of maize and their predicted yield from single crosses. Jour. Amer. Soc. Agron. 35: 60–65.

JENKINS, M. T. 1935. The effect of inbreeding and selection within inbred lines of maize upon the hybrids made after successful generations of selfing. Iowa State College Jour. Sci. 9: 429–530.

————, AND A. M. BRUNSON. 1932. Methods of testing inbred lines of maize in crossbred combinations. Jour. Amer. Soc. Agron. 24: 523–530.

JOHNSON, I. J., AND H. K. HAYES. 1936. The combining ability of inbred lines of Golden Bantam Sweet corn. Jour. Amer. Soc. Agron. 28: 246–252.

LOVE, H. H. 1943. Experimental methods in agricultural research. Puerto Rico Agric. Exper. Sta. Bull. 116–125.

SINGLETON, W. R., AND O. E. NELSON, JR. 1945. The improvement of naturally cross-pollinated plants by selection in self-fertilized lines. Connecticut Agric. Exper. Sta. Bull. 490: 457–498.

WERNHAM, C. C. 1952. Disease resistance and early testing of maize. Science 116: 57–58.

TABLE 1

Values necessary in determining the sum of squares and adjusted means of native inbreds

VARIETY	VARIETY TOTAL (a)	SUM OF BLOCK TOTALS CONTAINING VARIETY (b)	5(a)—(b) (c)	ADJUSTED MEAN YIELD .944186 + [(c) + 25]
C 1–1 C.F.	8.5127	28.7864	+ 13.7771	1.4953
36–6 C.F.	6.4284	34.1882	+ 2.0464	0.8623
41–1 C.F.	6.3595	29.9526	+ 1.8449	1.0180
33–2 C.F.	3.9140	24.4238	+ 4.8537	0.7500
27–2 C.F.	6.8202	31.3759	+ 2.7250	1.0532
35–2 C.F.	7.2007	28.9139	+ 7.0897	1.2278
15–5 C.F.	6.2773	26.7631	+ 4.6235	1.1291
7–2 C.F.	4.7025	27.1082	— 3.5957	0.8004
28–2 C.F.	4.6475	26.0716	— 2.8343	0.8301
2–4 C.F.	4.6738	29.2012	— 5.8321	0.7109
43–2 C.F.	7.2113	28.2850	+ 7.7714	1.2550
20–2 C.F.	6.3096	26.9500	+ 4.5982	1.1281
9–3 C.F.	4.7096	25.5052	— 1.9571	0.8659
5–3 C.F.	4.5567	28.5650	— 5.7817	0.7129
12–1 C.F.	7.0170	31.4078	+ 3.6773	1.0913
40–2 C.F.	8.5156	30.7064	+ 11.8713	1.4190
32–2 C.F.	6.3887	27.9987	+ 3.9447	1.1020
34–4 C.F.	3.4387	26.9777	— 9.7842	0.5528
42–1 C.F.	5.7657	29.4280	— 0.5996	0.9202
3–2 C.F.	5.3949	28.3985	— 1.4242	0.8872
C 13	4.5026	26.6633	— 4.1505	0.7782
C 14	4.5061	28.9792	— 6.4488	0.6862
C 17	4.7841	28.2526	— 4.3317	0.7709
C 19	4.2882	24.8888	— 3.4478	0.8063
Control (Cuban Flint)	6.5131	26.0752	— 9.5622	0.5617
Total	141.6279	714.4166	0	23.6046

Mean = 141.6279/150 = 0.9442 Mean = 23.6046/25 = 0.9442

TABLE 2

Analysis of variance

SOURCE	D.F.	S.S.	VARIANCE	F.
Total	149	22.4559	0.1507	
Blocks	29	5.9358	0.2047	
Varieties	24	7.6681	0.3195	3.4651
Error	96	8.8520	0.0922	

L.S.M.D. = 0.3812

TABLE 3

Values necessary in determining the sum of squares and adjusted means of South American inbreds

VARIETY	VARIETY TOTAL (a)	SUM OF BLOCK TOTALS CONTAINING VARIETY (b)	5(a)—(b) (c)	ADJUSTED MEAN YIELD 1.345 + [(c) + 25]
I 37–1 C.Y.F.	8.756	39.231	+ 4.549	1.52696
42–1 C.Y.F.	9.366	40.740	+ 6.090	1.58360
49–1 C.Y.F.	8.147	39.256	+ 1.479	1.40416
43–1 C.Y.F.	7.213	39.268	— 3.653	1.19888
68–2 C.Y.F.	9.522	41.816	+ 5.794	1.57676
15–3 C.Y.F.	6.545	40.834	— 8.109	1.02064
70–3 C.Y.F.	7.510	39.579	— 2.029	1.26384
59–2cC.Y.F.	8.111	40.358	+ 0.197	1.35288
36–1 C.Y.F.	6.947	39.994	— 5.259	1.13464
8–3 C.Y.F.	7.890	39.326	+ 0.124	1.34996
76–3aC.Y.F.	9.387	42.197	+ 4.738	1.53452
50–1aC.Y.F.	7.893	39.612	— 0.147	1.33912
38–1 C.Y.F.	7.383	39.557	— 2.642	1.23932
65–3 C.Y.F.	6.396	38.954	— 6.974	1.06604
60–1 C.Y.F.	7.192	40.261	— 4.301	1.17296
75–2 C.Y.F.	6.748	39.932	— 6.192	1.09732
86–6 C.Y.F.	8.972	41.883	+ 2.977	1.46408
51–1 C.Y.F.	9.230	39.649	+ 6.501	1.60504
96–2 C.Y.F.	5.995	43.286	—13.311	0.81256
9–1 C.Y.F.	8.301	40.301	+ 1.204	1.39316
I 99	9.104	40.227	+ 5.293	1.55672
I 69	8.858	39.307	+ 4.983	1.54432
I 71	9.581	45.121	+ 2.784	1.45636
I 72	8.438	37.434	+ 4.756	1.53524
Control (College Yellow Flint)	8.330	40.502	+ 1.148	1.39092
Total	201.725	1008.625	0	33.62500

Mean = 201.725/150 = 1.345 Mean = 33.625/25 = 1.345

TABLE 4

Analysis of variance

SOURCE	D.F.	S.S.	VARIANCE	F.
Total	149	26.4399	1.7745	
Blocks	29	10.2212	0.3535	
Varieties	24	5.5581	0.1899	1.5636
Error	96	11.6606	0.1215	

Not significant

TABLE 5

Performance of native inbreds in topcrosses

LINES	MEAN HEIGHT OF PLANT	MEAN HEIGHT OF EAR FROM THE GROUND	MEAN NUMBER OF LEAVES	SHELLING PERCENTAGE	YIELD	YIELD IN PER CENT OF COLLEGE YELLOW FLINT
	cm.	*cm.*			*kg.*	
C 1–1 C.F.	172.50 ∓ 4.56	71.77 ∓ 4.56	12.23 ∓ 0.51	83.71	1.4953 [a]	199.16
40–2 C.F.	149.93 ∓ 6.64	72.14 ∓ 4.02	12.14 ∓ 0.50	83.74	1.4190	188.99
43–2 C.F.	162.72 ∓ 4.77	70.28 ∓ 2.90	11.33 ∓ 0.28	74.65	1.2550	167.15
35–2 C.F.	157.18 ∓ 7.95	65.69 ∓ 3.92	10.95 ∓ 0.35	78.51	1.2278	163.53
15–5 C.F.	168.95 ∓ 9.55	64.68 ∓ 3.60	11.00 ∓ 0.46	73.16	1.1291	150.38
20–2 C.F.	151.13 ∓ 6.30	59.18 ∓ 3.40	11.82 ∓ 0.40	82.08	1.1281	150.25
32–2 C.F.	163.09 ∓ 6.85	82.86 ∓ 2.19	12.45 ∓ 0.36	82.81	1.1020	146.77
12–1 C.F.	158.42 ∓ 6.64	68.86 ∓ 1.10	10.52 ∓ 0.45	82.30	1.0913	145.35
27–2 C.F.	170.00 ∓ 6.62	70.34 ∓ 7.97	13.18 ∓ 0.41	84.58	1.1532	140.27
41–1 C.F.	170.53 ∓ 10.62	68.29 ∓ 0.98	14.14 ∓ 0.29	81.10	1.0180	135.58
42–1 C.F.	157.24 ∓ 5.43	59.24 ∓ 2.71	11.24 ∓ 0.33	83.99	0.9202	122.56
3–2 C.F.	156.15 ∓ 6.73	69.79 ∓ 3.45	12.00 ∓ 0.40	81.34	0.8872	118.16
9–3 C.F.	167.95 ∓ 5.83	76.42 ∓ 15.06	12.18 ∓ 0.31	88.28	0.8659	115.33
36–6 C.F.	183.11 ∓ 3.08	69.81 ∓ 3.11	12.30 ∓ 1.12	87.13	0.8623	114.85
28–2 C.F.	172.14 ∓ 7.15	80.71 ∓ 2.42	11.33 ∓ 0.94	83.28	0.8301	110.56
19–2 C.F.	150.09 ∓ 4.92	77.32 ∓ 1.15	9.82 ∓ 0.47	84.87	0.8063	107.39
7–2 C.F.	137.08 ∓ 6.37	63.71 ∓ 5.41	10.91 ∓ 0.82	85.89	0.8004	106.60
13–2 C.F.	127.82 ∓ 5.68	69.25 ∓ 2.09	12.72 ∓ 0.56	87.03	0.7782	103.64
17–2 C.F.	140.52 ∓ 7.32	59.78 ∓ 3.32	10.45 ∓ 0.47	87.11	0.7709	102.67
33.2 C.F.	163.83 ∓ 5.32	58.22 ∓ 3.96	12.67 ∓ 0.24	75.61	0.7500	99.89
35–2 C.F.	153.90 ∓ 7.64	74.90 ∓ 3.52	11.85 ∓ 0.46	81.85	0.7129	94.95
2–4 C.F.	168.45 ∓ 4.24	75.85 ∓ 3.62	11.05 ∓ 0.35	83.38	0.7109	94.68
14–1 C.F.	139.99 ∓ 4.97	72.47 ∓ 3.02	10.96 ∓ 0.29	86.21	0.6862	91.39
34–4 C.F.	168.13 ∓ 5.95	74.39 ∓ 3.45	12.61 ∓ 0.78	81.88	0.5528	73.63
College Yellow Flint .	160.33 ∓ 5.62	70.79 ∓ 2.92	11.32 ∓ 0.47	83.18	0.7508	100.00

[a] Significantly better yielder than College Yellow Flint.

L.S.M.D. = 0.3812

GERMINATION AND VARIABILITY STUDY OF SEVEN ABACÁ VARIETIES [1]

JESUS R. RICAHUERTA

WITH FOUR TEXT FIGURES

In 1919, a study of seed germination of eight varieties of abacá by the Division of Genetics, Department of Agronomy, showed that the percentage of germination ranged from 10 per cent to 68 per cent. In the same year the Department of Agronomy initiated the growing of abacá seedlings for the production of new varieties, but the work did not go beyond the demonstration of variability among young seedling plants.[2]

The present study was conducted (*1*) to find a better and more efficient method of germinating abacá seeds for the production of new seedling varieties and (*2*) to select the more desirable seedlings on the basis of height, number of leaves and roots, as well as other characteristics.

MATERIALS AND METHODS

Treatment of seeds. The four methods tried in germinating the abacá seeds were (*a*) pre-treatment with sodium hydroxide, (*b*) scarification, (*c*) stratification, and (*d*) sowing seeds without pre-treatment. Seeds of seven varieties of abacá collected in March, 1950, and in March, 1951, from several abacá plantations in Mindanao and Albay were used in this study.

Pre-treatment with sodium hydroxide. Two hundred milliliter solutions of 5 per cent, 2 per cent, 1 per cent, and ½ per cent sodium hydroxide were prepared. In every solution 200 seeds were soaked for 24 hours. After immersion the seeds were washed thoroughly with tap water and planted in ten rows for each treatment in separate seedboxes at the rate of 20 seeds to a row.

Scarification. In this method the seedcoats of the abacá seeds were scratched. This made it possible for the seeds to imbibe water, thus hastening germination. Scarification was done by rubbing the seeds on a homemade "seed scarifier" (fig. 1) for several minutes before planting.

Stratification. Layers of abacá seeds were placed alternately with layers of sand in a stratifying box that was left open at the

[1] Central Experiment Station Contribution No. 1651. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of Associate Professor P. A. David and Assistant Professor D. L. Umali.

[2] MENDIOLA, N. B. 1923. On the improvement of abacá (*Musa textilis* Née). Philippine Agricultural Review 16(2).

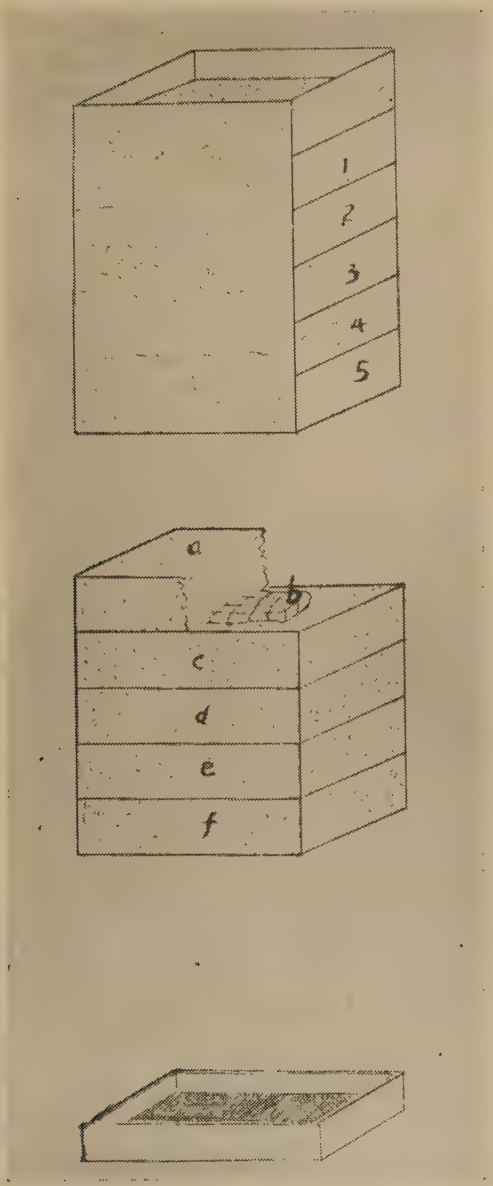

Fig. 1.—Upper panel, the stratifying box showing depth and number of soil layers. Middle, the seeds in between the layers of soil: (a) top layer, (b) the wrapped abacá seeds, and (c) to (f), the other layers. Lower panel, the homemade "seed scarifier."

top to facilitate watering as needed. The stratifying box is an ordinary wooden box 22 inches high, 1 foot wide, and 1 foot long; it holds several layers of soil of about 4 inches deep.

The abacá seeds were first divided into four groups of 200 seeds each. Each group was separately wrapped in cellulose papar to prevent mixture with the soil and to facilitate ease in retrieving them. Five layers of soil (fig. 1) were made so that each group of seeds was placed in between the layers of soil about 4 inches deep. To keep the soil constantly moist until the seeds were ready for transplanting, watering was done every three days. Since there were four layers of abacá seeds, the first layer was transplanted after one month of stratification, the sceond layer after two months, the third layer after three months, and the last layer after four months. The percentages of germination were determined.

Control. Two hundred seeds were directly sown in the seedbed without pre-treatment.

Preparation of the germination beds. Twelve ordinary seedboxes with sterilized sandy soil were used in the germination of the abacá seeds. Sterilization was done to render the soil free of any living organism. The soil was heated for eight hours on four sheets of galvanized iron which were mounted on two strong iron bars. A strong bamboo bench about 12 meters long and 60 centimeters high was constructed to hold the seedboxes together in a single row. All the seedboxes were properly labeled and set side by side in a straight line before they were filled with soil. Each box was then filled with the sterilized soil and made ready for planting.

Preparation of the pricking plot. A partially shaded lot, 12 by 30 meters, was selected. The soil was plowed twice and harrowed once. Furrows were made one meter apart.

Transplanting of seedlings. On June 26, 1951, or three months after germination, the seedlings were transplanted in the prepared plots. All the seedling varieties were planted in separate rows one meter apart and about 30 centimeters betwen plants.

Care of the transplanted seedlings. Frequent watering was done during the first three weeks after transplanting. The plants were examined every morning and afternoon for the presence of the giant African snail, *Achatina fulica* Fer., which was found eating the leaves of the abacá seedlings. The weeds were removed as soon as they appeared.

Measurements. Since the stratification method gave the highest percentage of germination, it was decided to germinate the seeds of the seven varieties by this method. Two hundred seeds from each variety were germinated, with the exception of Pula of which there were only 85 seeds. The seedlings were used in the variability study. They were grown in seedboxes for three months. Their heights

were measured and their leaves counted at the end of each month. Then the seedlings were transplanted in the pricking plot where further variability study was made. Measurement of the heights and counting of the leaves of the seedlings were done every month until the seedlings were six months old. The roots were also counted, but the counting was started two months after transplanting because the seedlings developed new roots when they were about one and one-half months old in the pricking plot.

RESULTS AND DISCUSSION

Nursery observations

Relative effectiveness of the four methods. In the first trial, the stratification method (table 1) gave better results than the other methods used. The scarified seeds and the control gave only 2.5 and 2.0 per cent germination, respectively, whereas seeds treated with sodium hydroxide failed to germinate. The germination was, in general, very low, probably because of the fact that the abacá seeds collected by Dr. D. L. Umali and by Drs. R. B. Espino and J. R. Velasco in Mindanao in the summer of 1950 were already five months old when planted. Ferrer and Espino [3] found that abacá seeds lose their viability after three months.

Fig. 2.—Abacá seeds stratified for one month. (*Photographed by Photographic Division*)

[3] Ferrer, L. G., and R. Espino. 1923. Study on the germination of abacá seeds. Philippine Agriculturist 12: 502–612.

In the second trial (table 2) in which three-month-old seeds were used, the percentage of germination in the stratification method was 60 per cent. It was noted, however, that in both trials only those seeds that germinated after one month of stratification were fit for planting. While the roots were just beginning to appear, the length of the plumules ranged from 1 millimeter to 1 centimeter (fig. 2). Upon planting the stratified seeds in the seedbox, rooting took place readily, and the plumules produced leaves immediately. Seeds after two to four months of stratification (fig. 3) were unfit for planting. The plumules had grown 2 to 5 inches long and were rather weak, tender, and slender. When planted in the seedbed, the

Fig. 3.—Abacá seeds stratified for two months. (*Photographed by Photographic Division*)

seedlings could not stand upright. In addition to this undesirable feature, most of the roots were found dry or rotting, perhaps because of prolonged stratification.

Table 3 shows the percentage of germination of the different abacá varieties germinated by the stratification method. Under this method, the percentage of germination obtained (table 3) ranged from 52.5 per cent in Binagacay to 78.8 per cent in the variety Pula.

Height and number of leaves of seedlings grown in the seedbox. The seedlings of the different varieties showed no marked difference in height and number of leaves one month after germination. The mean height of the different varieties (table 4) ranged from 2.5 centimeters to 3.2 centimeters, and the mean number of leaves (table 5) ranged from 3 to 3.9.

At the age of two months, Bulao measured a mean height of 7.9 cm. Puti and Binukid gave mean heights of 5.7 cm. and 5.4 cm., respectively. Pula gave a mean height of 4 cm.; Bongolanon, 3.7 cm.; Itom, 3.3 cm.; and Binagacay, 3 cm. Bulao had a mean of 5 leaves; Bongolanon, 4.6; Pula, 4.5; Puti, 4.1; and Binagacay, 4.

When the seedlings were three months old, Bulao measured a mean height of 10.4 cm. Binukid and Puti had mean heights of 7.6 cm. and 7.4 cm., respectively. Bongolanon and Itom both had a mean height of 5.8 cm.; Binagacay had a mean height of 5.7 cm.; and Pula gave a mean height of 5.6 cm. Itom had a mean of 6.8 leaves; Pula, 6.7; Binagacay, 6.6; and Bongolanon, 6.4. Bulao had 5.3 leaves; Binukid, 4.9; and Puti, 4.6.

Field observations

Pests and diseases. The seedlings of the different varieties were uniform in color. Four months after transplanting, some of the seedlings of the Binagacay variety showed symptoms of bunchy-top disease.[4] One month later, leaf spot and anthracnose attacked the varieties Binagacay, Bongolanon, Pula, and Itom. Giant African snail and banana leaf roller attacked the seedlings. The snail fed upon the leaves of the young abacá plants, whereas the banana leaf roller produced rolls and cuts on the blades of the leaves.

Number of suckers. Bulao produced suckers four months after transplanting. In the fifth month, production of suckers was also noted in the Binukid and Puti varieties. The suckers produced ranged from one to five a plant.

Height of plants. Six months after transplanting, the height of the seedlings (table 6) ranged from 29 ∓ 1.89 cm. in Bongolanon to 64 ∓ 3.44 cm. in Bulao. Puti was the second highest with a mean height of 62 ∓ 2.51 cm. Binukid with a mean height of 59 ∓ 3.64 cm. was third. Pula and Binagacay had mean heights of 43 ∓ 2.35 cm. and 31 ∓ 1.56 cm., respectively. Statistical comparison showed that the differences in height of the different varieties were significant except those between Binagacay and Bongolanon, Binukid and Bulao, Pula and Puti, Bulao and Puti, and Itom

[4] Identified by Dr. F. T. Orillo of the Department of Plant Pathology.

and Pula. Binukid (table 7) was the most variable in height, and Bongolanon was the least variable (fig. 4).

Number of leaves. The mean number of leaves (table 6) ranged from 8 ∓ .11 in Binagacay to 11 ∓ 1.16 in Puti. Bongolanon had a mean of 9 ∓ .08 leaves, and all the rest had a mean of 10 leaves. When treated statistically, the differences in number of leaves were significant except those between Pula and Puti; Binukid with Bulao, Itom, Pula, and Puti; Bongolanon and Puti; and Bulao and Puti. Puti (table 7) was the most variable as it showed the highest coefficient of variation (73.09 per cent). Bulao was the least variable with 15.40 per cent.

Fig. 4.—Seedlings of different varieties of abacá in the nursery 6 months after transplanting. (*Photographed by Photographic Division*)

Number of roots. The mean number of roots ranged from 10 ∓ .27 in Itom to 20 ∓ 1.10 in Bulao. Binukid ranked second with a mean of 17 ∓ .10 roots. Puti gave a mean of 15 ∓ .31 roots; Binagacay, 15 ∓ 0.2; and Pula, 12 ∓ .25. The differences in number of roots among the different varieties were significant except those between Binagacay and Binukid, Bongolanon and Itom, Binagacay and Puti, Bongolanon and Pula, Puti and Pula, and Binukid and Puti. Itom was the most variable in number of roots, with 60.70 per cent coefficient of variation. Bulao (table 7) was the least variable.

Of the seven varieties studied, Bulao, Puti, Binukid, and Itom are the most promising varieties.

SUMMARY

1. Of the four methods of germinating abacá seeds, stratification was found to be the best.

2. Seeds of the seven abacá varieties gave different percentages of germination. Binagacay had 52.5 per cent; Itom, 54.0 per cent; Bongolanon, 55.0 per cent; Puti, 58.0 per cent; Binukid, 67.0 per cent; Bulao, 67.5 per cent; and Pula, 78.8 per cent.

3. At the age of three months of the seedlings of the different varieties, the mean height ranged from 5.6 centimeters to 10.4 centimeters. The seedlings produced a mean of 5.9 leaves.

4. Six months after transplanting, the mean height of the seedlings of the different varieties ranged from 29 $\mp$ 1.89 centimeters to 64 $\mp$ 3.44 centimeters; Bongolanon was the shortest and Bulao the tallest. The mean number of leaves of the different varieties ranged from 8 $\mp$ .11 to 11 $\mp$ 1.16. Binagacay had the least number of leaves and Puti had the most.

5. The mean number of roots ranged from 10 $\mp$ .22 to 20 $\mp$ 1.10. Six months after transplanting, Bulao had the greatest number of roots and Itom had the least.

6. The variety Binukid was the most variable in height; Itom, the most variable in number of roots; and Puti, the most variable in number of leaves.

7. Of the seven varieties studied, Bulao, Puti, Binukid, and Itom are the most promising varieties.

TABLE 1

Percentage of germination in the first trial of abacá seed germination [a]

METHODS	NUMBER OF SEEDS USED	NUMBER OF SEEDS GERMINATED	PERCENTAGE OF GERMINATION
			per cent
a. Sodium hydroxide treatment			
5 per cent	200	0	0
2 per cent	200	0	0
1 per cent	200	0	0
½ per cent	200	0	0
b. Stratification			
1 month	200	12	6.0
2 months	200	25	12.5
3 months	200	28	14.0
4 months	200	25	12.5
c. Scarification	200	5	2.5
d. Control	200	4	2.0

[a] Age of seeds, 5 months.

TABLE 2

Percentage of germination in the second trial of abacá seed germination [b]

METHODS	NUMBER OF SEEDS USED	NUMBER OF SEEDS GERMINATED	PERCENTAGE OF GERMINATION
a. Sodium hydroxide treatment			
5 per cent	200	0	0
2 per cent	200	0	0
1 per cent	200	4	2.0
½ per cent	200	25	12.5
b. Stratification	200	120	60.0
c. Scarification	200	35	17.5
d. Control	200	34	17.0

[b] Age of seeds, 3 months.

TABLE 3

Percentage of germination by stratification for one month

VARIETIES	NUMBER OF SEEDS USED	NUMBER OF SEEDS GERMINATED	PERCENTAGE OF GERMINATION
			per cent
Binagacay	200	105	52.5
Binukid	200	134	67.0
Bongolanon	200	110	55.0
Bulao	200	135	67.5
Itom	200	108	54.0
Pula	85	67	78.8
Puti	200	116	58.0

Note: Age of seeds, 1 month.

TABLE 4

Mean height of seven varieties of abacá seedlings at different ages[a]

VARIETIES	AGE		
	1 month	2 months	3 months
	cm.	*cm.*	*cm.*
Binagacay	2.8	3.0	5.7
Binukid	3.2	5.4	7.6
Bongolanon	2.5	3.7	5.8
Bulao	2.7	7.9	10.4
Itom	2.9	3.3	5.8
Pula	2.8	4.0	5.6
Puti	2.5	5.7	7.4

[a] Mean of 50 plants.

TABLE 5

Mean number of leaves of seven varieties of abacá seedlings at different ages[a]

VARIETIES	AGE		
	1 month	2 months	3 months
Binagacay	3.6	4.0	6.6
Binukid	3.5	3.9	4.9
Bongolanon	3.6	4.6	6.4
Bulao	3.9	5.0	5.3
Itom	3.0	4.3	6.8
Pula	3.5	4.5	6.7
Puti	3.4	4.1	4.6

[a] Mean of 50 plants.

TABLE 6

Mean height, number of leaves, and number of roots of six-month-old seedlings of seven abacá varieties[a]

VARIETIES	CHARACTERS MEASURED		
	Height	Leaves	Roots
	cm.		
Binagacay	31 ∓ 1.56	8 ∓ .11	15 ∓ .10
Binukid	59 ∓ 3.64	10 ∓ .08	17 ∓ .10
Bongolanon	29 ∓ 1.89	9 ∓ .08	12 ∓ .02
Bulao	64 ∓ 3.44	10 ∓ .07	20 ∓ 1.10
Itom	42 ∓ 2.46	10 ∓ .08	10 ∓ .27
Pula	43 ∓ 2.35	10 ∓ .09	12 ∓ .25
Puti	62 ∓ 2.51	11 ∓ 1.16	15 ∓ .31

[a] Mean of 50 plants.

TABLE 7

Variability in number of leaves and roots and in height of six-month-old abacá seedlings

VARIETIES	COEFFICIENT OF VARIATION		
	Height	Number of leaves	Number of roots
	cm.	*per cent*	*per cent*
Binagacay	35.54	29.37	45.00
Binukid	43.64	17.10	40.35
Bongolanon	10.83	19.11	39.33
Bulao	38.01	15.40	37.15
Itom	39.92	16.70	60.70
Pula	38.53	19.30	46.33
Puti	25.56	73.09	43.60

COLLEGE AND ALUMNI NOTES

Mr. E. J. Bell, director of the Agriculture Division of STEM of the U. S. Economic Cooperation Administration, was convocation speaker on January 23, 1952. He spoke on the role that the College and its Central Experiment Station play in the development of Philippine agriculture. He emphasized the importance of bringing new knowledge to the farmer and the homemaker. A luncheon was tendered in his honor after the program.

The Board of Regents, in its meeting on December 20, 1951, approved the designation of Professor Montgomery E. Robinson as project leader of the group of Cornell professors who are joining the College staff as part of the cooperative arrangement between the two institutions. Professor Robinson has been a member of the administrative staff of the College of Agriculture of Cornell University for thirty years, working with its subject-matter staff in coordinating extension programs and dealing with the interrelationships of research, resident instruction, and extension teaching. He holds degrees from both Princeton University and Cornell University. During the last few years as "contact" officer, he has done an outstanding job of handling the large number of visiting scientists, government officials, and students from abroad on ECA, Point IV, and other government-sponsored programs.

Undersecretary Jose S. Camus, '14, chairman of the Philippine delegation, Dr. Deogracias V. Villadolid, '19, director of the Bureau of Fisheries, and Dr. Gonzalo Merino, '14, director of the Bureau of Plant Industry, returned from the FAO conference held recently in Rome, Italy.

Mr. Faustino Q. Otanes, '18, chief of the Plant Pest and Disease Control Division of the Bureau of Plant Industry, was the officer-in-charge of the bureau during the absence of the director, Dr. Gonzalo F. Merino.

Mr. Demetrio S. Santos, '36, was recently appointed member of the Import Control Commission.

Mr. Pascual N. Andres, '32, has been appointed superintendent of the Iwahig Penal Colony in Palawan.

Mr. Thomas G. Flores, '51, instructor in agronomy of the College was married to the former Miss Leonora V. Chavez at Cagayan de Oro City on December 27, 1951. The bride is a holder of a B.S. degree and has taught biology at the Pilgrim Institute in Cagayan de Oro City.

Messrs. Cenon R. Flor Cruz, '35, Pedro C. Gabertan, '34, Ernesto P. Gabriel, '40, and Eleazar M. Galano, '45, were among the candidates who successfully passed the bar examination given by the Supreme Court in August, 1951.

A scientific meeting of the Los Baños Biological Club was held on January 25, 1952, at the Agricultural Chemistry Lecture Hall. Mr. Jorge G. Davide of the Department of Soils read a paper on the effects of varying amounts of exchangeable bases on the yield and on the lime and phosphoric acid contents of lettuce (*Lactuca sativa* Linn.).

The alumni of the College played prominent roles in the agricultural engineering convention which was held in Manila on February 1 to 3, 1952. Among the officers of the Philippine Society of Agricultural Engineers are the following: Alejandro B. Catambay, '24, president; Ernesto L. Rigor, '36, secretary-treasurer; Jesus P. Mamisao, '30, business manager; Teofilo M. Mendoza, '49, and Rufo H. Ocfemia, '46, assistant business managers; Ignacio R. Ang, '32, circulation manager; and Silvino C. Hernandez, '29, acting circulation manager. On the board of editors of the Philippine Agricultural Engineering Journal are Jesus P. Mamisao, '30, Ernesto L. Rigor, '36, Alejandro B. Catambay, '24, Anastasio L. Teodoro, '18, Julian M. Eulanadi, '35, and Abelardo F. Baclig, '46. Others who took active part in the convention were the following: Salvador B. Oliveros, '33, of the Philippine Sugar Institute; Guillermo P. Santos, '48, of the NARIC; Anastasio L. Teodoro, '18, of Marsman and Company; Alexander Gordon, '23, of La Carlota Sugar Central; Eugenio E. Cruz, '25, of the Bureau of Plant Industry; and Pedro A. David, '19, of the College of Agriculture. On the committee on reception were Teofilo M. Mendoza, '49, Levy A. Trinidad, '51, and Manuel C. Esguerra, '51.

Miss Nora J. Cruz has joined the College as copy editor of the *Philippine Agriculturist* effective January 14, 1952. She graduated from the U. P. College of Liberal Arts with the degree of Bachelor of Arts, *magna cum laude,* major in English.

Miss Virginia Samson was recently appointed to the staff of the Department of Entomology. She completed her A.B. degree, major in zoology, from the College of Liberal Arts in November, 1951.

THE CENTRAL EXPERIMENT STATION

LIST OF AVAILABLE PUBLICATIONS

No. 2.—Bud Rot of Coconut ..... *By G. O. Ocfemia*

No. 8.—Horse Breeding in the Philippines ..... *By V. Villegas*

No. 11.—The New College Copra Drier ..... *By Moises M. Kalaw* (Revised)

No. 17.—College Trapnest ..... *By F. M. Fronda and P. S. Paje*

No. 18.—Surveying for Area with a Surveyor's Staff ..... *By Alexander Gordon*

No. 23.—Curing Pork and Making Sausage for Home Use ..... *By Mariano Mondoñedo*

No. 24.—Construction and Operation of Silos in the College of Agriculture ..... *By J. P. Esguerra*

No. 29.—Collegiate Education in Agriculture ..... *By Leopoldo B. Uichanco*

No. 30.—What Should Filipino Ornamental Gardens and Ornamental Plants Be? ..... *By N. B. Mendiola*

The price of the circulars listed above is thirty centavos (P0.30) each.

All orders for circulars with payment should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

PHILIPPINE AGRICULTURE, Volume 1 { Cloth bound ..... P10.00; Postage 0.40

A MANUAL OF PLANT BREEDING FOR THE TROPICS P6.00

All orders for books with remittance should be addressed to:

THE DEAN AND DIRECTOR
COLLEGE OF AGRICULTURE AND
CENTRAL EXPERIMENT STATION
COLLEGE, LAGUNA, PHILIPPINES

THE PHILIPPINE AGRICULTURIST
(Formerly The Philippine Agriculturist and Forester)

Published by the COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

SWORN STATEMENT

(Required by Act No. 2580)

The undersigned, business manager of THE PHILIPPINE AGRICULTURIST, published monthly except April and May, in English at the College of Agriculture, College, Laguna, after having been duly sworn in accordance with law, hereby submits the following statement of ownership, management, circulation, etc., which is required by Act 2580, as amended by Commonwealth Act 201:

Editor: Dean L. B. Uichanco, College, Laguna, Philippines
Managing Editor: Dr. G. O. Ocfemia, College, Laguna
Business Manager: Dr. J. M. Capinpin, College, Laguna
Publisher: College of Agriculture and Central Experiment Station, University of the Philippines, College, Laguna, Philippines.

Owners or stockholders holding one per cent or more of total amount of stock: University of the Philippines, Diliman, Quezon City, Philippines.

Bondholders, mortgagors, or other security holders owning one per cent or more of total amount of securities: None.

Total number of copies printed and circulated, March 3, 1953: 1,470.

(Sgd.) J. M. CAPINPIN
Business Manager

Subscribed and sworn to before me this 27th day of March, 1953, at Los Baños, Laguna, the affiant exhibiting his Residence Certificate No. A-4094007 issued at Los Baños, Laguna, on January 2, 1953.

Doc. No. 56;
Page No. 57;
Book No. 1;
Series of 1953.

(Sgd.) ISIDRO P. GUICO
Notary Public
Until December 31, 1953